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Eri Silk

Source—Properties—Processes of Degumming, Bleaching and Dyeing —Improvements in Processing Methods

By FRED GROVE-PALMER, A.I.C.

THE natives of certain parts of India raise several kinds of wild silk by way of a home industry, doing it on the side in conjunction with their other agricultural pursuits. Of these wild silks, Eri is one. It is of some little commercial value and might be made much more so.

From the point of view of the scientific entomologist, two distinct sorts of Eri, or, as it is sometimes called, Eria, are to be met with. These are called, respectively, *Attacus cynthia* and *Attacus ricini*. There are some differences in the appearance of the wings of the moths and there is a greater quantity of whitish scales upon the abdomen of one than on the other.

Professor Leroy-Maxwell, who died some years or so ago, a victim to science, studied these moths closely, and found that *A. cynthia* is the one which spins a darkish brown cocoon which is wrapped up in a leaf, while *A. ricini* yields a fine white, fluffy cocoon which is the principal source of the supply of Eri silk that is obtained from the forests of Assam. *A. cynthia* is met with wild in many parts of India and China, and efforts have been made from time to time to grow it in other parts of the world. It has been bred in Italy and southern France, and also in some places in the Southern States of America, but very little has been done in the way of serious work in either continent. It is more than probable that the cost of labor is far too great ever to make it a paying proposition in America, where up to the present the far superior mulberry silkworm has not been producible in commercial quantities.

John Henry Watson was another entomologist who studied the life history of the Eri silk moth very devotedly, and he has put it on record that the Assamese moth is not a pure species at all, but a hybrid. He found that not only would *cynthia* and *ricini* interbreed freely by their own choice, but that all the many species of *Attacus* would do the same. Naturally, this is not conducive to any sort of regularity in the quality of the silk that is obtained from native sources.

Judged by a comparison with other kinds of silk that occupy positions in the world's commercial textile fiber markets, Eri is not very important, though there was a time during the Great War when the demand for it grew far beyond anything previously known. Silk of any kind was badly wanted, owing to the wholesale destruction of the mulberry plantations in Asia Minor, and the inability of other nations to devote their attention to the production of the usual crops. Consequently there were quite considerable shipments of Eri as well as other wild silks by the merchants of Calcutta.

Eri is not one of the silks that passes through the filatures; it is never sold in the markets in the form of reeled skeins but as split or pierced cocoons. The reason that has been ascribed to this sounds a little far-fetched but is nonetheless probably quite correct. It is said that it is largely a matter of the religious belief of the sericulturists. These wild Assamese tribes have a religion which is animistic in character, which seems to imply, though it is dangerous ground for anyone not skilled in the study of primitive religions to tread, that they regard the emergence of the beautiful moth from the rough, dead-looking cocoon as a symbol of the soul rising from the body after death and, therefore, with a view to helping themselves at a later date when they may need it, they slit open the cocoon and eat the chrysalis. Of course, plenty of the moths hatch out and eat their way through the cocoon and others, probably those produced by tribes whose religion is not quite so strongly developed, are just smothered and the cocoons shipped with the dead pupae inside. These are not sorted by the merchants but are all collectively treated as splits and used for the manufacture of spun silk.

The native silk raisers employ the greater part of their crops for their own domestic purposes, and any that is left over may be sold. Many of the producers carry on only a very small business, and because of this the amount brought into the local village fairs and markets is not large and varies considerably from

season to season. Spun thread and hand-woven fabrics are also sold at these fairs. The principal crops of the year are obtained during the months of February and March, and then there is the interval until September, when the supply is good again until November. The summer months are too damp to render it possible to grow the silk and, especially in the hill districts, the two winter months are far too cold for successful raising.

Raising of the Wild Worms

The "seed" is purchased at the local markets and, as is the case with other kinds of wild silks, the surplus females are tied to trees in order that they may be fertilized by wild males. The rearing of the worms is carried on on trays, in a way not altogether unlike that employed for mulberry silk, but of course these very primitive people do not study the health and comfort of the insects in the same way nor with the same care and attention which the Japanese, for instance, devote to their crops and which have resulted in the enormous growth of the industry.

When the worms are reaching the end of the feeding stage and are showing signs of wanting to spin, they are allowed to creep into bunches of leaves that are tied up and placed on the trays. These leaves may be either those of the Kesiru (*Heteropanax fragrans*) or of the castor oil plant. These two plants are to be met with in the wild state but are also cultivated in small patches by certain of the small landowners, who sell the leaves to the silk growers. In the majority of cases, however, the growers have their own tiny patches of leaf plants and cultivate just sufficient for their own needs. The tribes generally are far too unenterprising to have large plantations or to take any special pains to ensure good supplies of foodstuffs. A family rarely calls upon outside help and the amount of silk grown depends entirely upon the number of available "hands" dwelling in the hut.

Lack of education in the details of sericulture prevents any attempt at getting the best out of the crop. As the cocoons are spun some of them are put aside for seed for the next crop. When the moths emerge the spoilt cocoons are sent forward for sale. Others are kept by the grower for his own use and, if his religion permits of it, they are stifled by means of heat and the girls of the family reel the filaments on a rough but fairly effective hand-driven reel.

The two chief enemies of the Eri silk moth in the jungles of Assam and India are the parasitic flies and "flacherie." This latter is one of the diseases that are common to silkworms of all kinds and arises from improper feeding, which gives rise to bacterial fermentation in undigested food.

Nothing is done with a view to lessening the losses that take place from these causes. The only way to keep off the parasitic flies would be to grow the worms in mosquito nets. This would necessitate the enclosure of the whole of the rearing sheds and, as these are the dwelling places of the silk raiser and his family, it is utterly out of the question. With regard to flacherie, it is of course impossible that such uncivilized people should have the requisite scientific knowledge and apparatus to be able to cope with a disease that has taken the full attention of trained biologists to combat. These untutored natives are resigned to what happens; if the silkworms persist in dying off, they let them and probably burn a little more incense in front of the local deity with a view to propitiating him and getting better luck next time.

Export of Eri cocoons is practically confined to Calcutta, from which port they are sent to the various spinners who require them. The actual figures showing the quantities sent to the different countries do not appear to be available, being included under the general heading of silk cocoons. The only information obtainable is from native sources and has been described as being quite unreliable because of the difficulty in assessing the amounts received from the different up-country collecting stations and the secrecy of the Calcutta merchants, who are jealous of each other's trade. The quantities quoted vary from none at all up to 250,000 pounds per annum.

A Primitive "Weighting" Process

Although Eri silk has a very good value in the manufacture of schappe, it is not one of the popular varieties of fiber that reach the market and, because of this, the price of the commodity seldom fluctuates in an upward direction sufficiently to induce any great activity in the production. If there is a slight increase in the monetary value the gentle savage has just enough sense to set his family to work filling up the split cocoons with stones and mud so as to increase the weight of his consignment. When the spinner discovers that his delicate machinery is being clogged up with aggregations of this "near silk" he gets back on the supplier and eventually the price falls again to a level that makes it scarcely worth while handling the material. This is a great pity, for the fiber is good and the merchants realize this; consequently they have, with a view to countering the acute business instincts of the harmless native, introduced a machine which is known as the Coryton Cocoon Reverser. This is the invention of a man who saw how the trade was being killed by the misguided commercial astuteness of the growers. The machine, which is described briefly by Leroy-Maxwell, turns the cocoons inside out and throws out all the dirt and other things that have been inserted. There is a large model of this machine, power driven, for the use of the big merchant, and another smaller, hand controlled, which is invaluable to the man in the country districts who handles only small quantities. He can therefore buy by weight of

cleaned cocoons and runs less risk of having to face a come-back from some irate purchaser. The more general use of these machines should be a factor in raising the price of the silk because there will undoubtedly be an increased demand for a cleaned quality, and this should induce the native to play for larger harvests.

Spinners and weavers of schappe in many parts of America and other countries have begun to understand how useful Eri will be in improving the strength and reducing the cost of the fabrics, for the tensile strength of the fiber is fine, and there are numerous enquiries received from time to time in Calcutta for larger supplies of the cocoons. Instead of limiting the production to the wilds of Assam, which are very inaccessible to proper control, attempts have ben made to add the culture of Eri to that of the ordinary mulberry worm in Kashmir and other parts of India, notably in Bengal. Up to the present day there has been little success attending these efforts, not because it cannot be grown but because the necessary organization for handling the crop does not exist. When it is considered that the perfectly simple and primitive people of the Assamese jungle can deal with the matter even in an imperfect manner and yet make a fair showing, it is incredible that the same or a similar but better organization cannot be formed to deal with the harvest in India. Of course it could be done. It is only a question of how to begin. Shall we grow the silk and then organize the sale of it or shall we organize the sale and then ask the people please to produce something for sale? It is only a question of time before the apparent deadlock is removed and the log set floating properly, and when we are inclined to be impatient at the crass stupidity of the people it should be remembered that always in matters concerning primitive races the introduction of any change that savors of being revolutionary there are high walls of prejudice and conservatism to be overcome.

Bleaching Eri Silk

By far the greater portion of the harvest of Eri silk collected in Assam is reeled or spun into coarse yarns and woven up into clothing for the people who raise it or for their neighbors, but the cocoons that are received by our spinners have to be put through a careful treatment before the fiber is clean enough to be used in the beautiful fabrics that gladden the hearts of our women folk.

Owing to the mixed nature of the silk, the first great need is bleaching. To enable this to take place the silk must first be freed from its heavy coating of sericin, which is greater and more difficult to remove than the gum of ordinary silk. For this treatment the following bath has been found very successful:

Water	120 gals.
Boric acid	9 lbs.
Caustic soda	6 lbs.
Soap	2 lbs.

The process, which is much more drastic than would be permissible with mulberry silk, is to enter the fiber at a temperature of from 195° to 200° F. and keep it at that for an hour or even longer. Care should be exercised to prevent the bath from actually reaching the boiling point, as, being so concentrated, it would in all probability seriously affect the substance of the silk and greatly reduce the luster of the fiber.

There is said to be an alternative method, which avoids the risk of working in an alkaline bath, that is so close to the danger point. This is by prolonged exposure to the action of the enzymes of malt. Although the writer has not been able to get successful results from his experiments in this direction, it has been recommended as having given good results in other hands and is therefore mentioned in order that advantage may be taken of it. The process is to steep the fiber in solution containing from 5% to 10% of malt extract for at least 24 hours, maintaining the temperature throughout at 135°. If the temperature rises much above this the enzymes will be destroyed, while if it is allowed to fall below their action is checked. The silk which has been thus soaked is then placed in a bath made on the following lines:

Water (softened)	120 gals.
Marseilles soap	20 lbs.
Sodium carbonate (dry)	1 lb.

The soaking is continued for one hour and the temperature kept at 195°, after which, it is confidently stated, the silk is thoroughly degummed.

Another method found to be quite useful is the result of German research by a chemist whose name has not come down to us. The formula is:

Water	120 gals.
Caustic soda lye (sp. gr. 1.384)	6 gals.
Glucose (solid)	45 lbs.

The fiber is steeped in this for one hour at 195° and then is moved about for a quarter of an hour in a soap bath at the same temperature:

Water (softened)	120 gals.
Marseilles soap	20 lbs.

This removes the gum. The object of the glucose is to act as a buffer in preventing the undue action of the caustic alkali upon the fibroin while it is softening and assisting in the removal of the gum.

It should not be forgotten that every shipment of

(*Continued on page* 549)

The Prevention of Mildew in Cotton Goods

Introduction: Requirements of the Ideal Antiseptic—Some Common Antiseptics—Purpose of the Study and Its Scope—The Experimental Investigation—Black Mould—The Antiseptics Used—Progress of the Tests—A Photographic Record—Toxicity of Neomerpin—Comparative Costs

By JOHN V. KILLHEFFER
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[EDITOR'S NOTE.—*The following thesis was presented by the author toward the degree of Bachelor of Textile Chemistry. It was awarded the Textile Colorist prize of $100 at the Annual Commencement of Lowell Textile Institute in June, and is here reprinted by special permission from the Textile Colorist.*]

INTRODUCTION

THE growth of the fungi responsible for mildew damage to cotton goods depends chiefly upon three factors: temperature, moisture, and the supply of available food material. If one of these factors can be eliminated or rendered unfavorable, development can no longer take place. In practice, control of temperature can be exercised only to a very limited extent; and the exclusion or control of moisture is impracticable from many angles; involving as it does extra operations and care throughout the manufacturing processes. The addition to the cloth (or yarn) during the sizing and finishing of materials suitable for the growth of mildew increases the chances of fungal growth, but the use of poor nutrients such as farina and sago starches instead of the flours may effect a considerable reduction in liability. This, however, does not give complete protection, and the exigencies of sizing do not generally permit of the selection of adhesives merely according to their liability to mildew. It is possible, nevertheless, to render even the most nutritious substances unfit for fungal growth by the addition of toxic materials. In practice the method generally used is the addition to the size or finish of some antiseptic compound which inhibits the development of the moulds.

There are numerous substances which can be used in the laboratory to effect complete inhibition of the growth of fungi, but there are so many limitations in practice that the choice of a suitable antiseptic is severely limited.

(1) In order to obtain easy incorporation with the size, the antiseptic must be fairly soluble in water at the temperature of the mixing.

(2) After being added to the size or finish, the antiseptic must remain unchanged. If it is volatile with steam it will boil out, and if it is decomposed by heat its antiseptic properties may be lost.

(3) The color of the size or finish must not be altered by adding the antiseptic—unless the result happens to be favorable or can be counteracted easily by suitable tinting. Many highly colored substances are excluded for this reason; and others which, though in themselves colorless, develop color when used in a size mixing.

(4) The possession of an odor may be very objectionable if it is imparted to the cloth.

(5) Tendering of the yarn or fabric must not be produced, either by direct action as of strong acids or oxidizing agents, or by decomposition on heating, which is generally recognized as the objection to the use of zinc chloride.

(6) The dyeing and finishing properties of the yarn or fabric must not be affected.

(7) The antiseptic must have no action upon those parts of the machinery with which it is likely to come in contact.

(8) Safety in handling the antiseptic is essential.

(9) There must be no action on the constituents of the size or finish which will affect the characteristic feel or other properties of the resulting fabric.

(10) To be of practical value the antiseptic must be obtainable with ease in sufficient quantities and cheaply enough for regular use. Cheapness depends, however, not only upon the price per pound, but also on the amount which must be used.

The ideal antiseptic for use in sizing and finishing must satisfy most of the above conditions, and this limits the choice very considerably and increases the difficulty of the search.

Illustrative of the above, a list is given below of some common antiseptics, many of which have been tried in textile work, and the objections to their use.

Zinc Chloride	Acid reaction, thins size, tendering action, considerable specific differences in toxicity to mildews.
Copper sulphate	Acid reaction, thins size, color.
Formaldehyde	Volatile, irritating odor.
Phenol and Cresol	Odor.
Thymol	Too expensive.
Salicylic Acid	Color in presence of acid, loses toxicity in presence of alkali.
Naphthalene	Odor.
Boric Acid	Weak, considerable specific differences.

No antiseptic has as yet appeared that would be ideal for textile work under the conditions set forth above. The problem, therefore, resolves itself into a search for a better textile antiseptic.

The most potent reason for the author's choosing the present topic as the subject for his thesis was its scope. The investigation has involved many different fields of work in its various aspects: Microbiology, Chemistry, Microscopy and Photomicrography, Textile Testing, etc. While it was hoped that positive results of some value would be obtained, nevertheless, this object was considered as subordinate to the primary end of undergraduate theses; namely, to teach the technique of attacking an original problem on one's own initiative, to show the student how to utilize his time to best advantage, and to train him in making reports. From this point of view, the subject has been ideal. Many opportunities have been provided for the investigator to use all the facilities at his command and to apply the teachings of his various sources of study.

The literature concerning the control of mildew in textiles by means of antiseptics is not large. Leslie Ewart Morris, M.A., D.Sc., has done considerable work for the British Cotton Industry Research Association and his results have been published. His reports have been carefully studied and of great assistance. To a certain extent the present work has been a follow-up of his work, and some of the testing methods were patterned after those used by him. David and Dreyfus: "Sizing and Mildew in Cotton Goods"; Martin: "Botany, with Agricultural Applications"; and Giltner: "Microbiology" were also consulted.

The Experimental Investigation

In view of the diverse nature of the factors which influence the growth of mould fungi on cotton goods, it was decided to carry out a preliminary investigation of the action of the antiseptics in artificial culture. In this way the nature and quantity of the antiseptic can be varied with ease while keeping other conditions unaltered. After the toxicity of the various substances had been determined in this manner, tests to determine their suitability under the ten requirements given above were undertaken.

The culture medium chiefly used for the preliminary experiments was a 1.5% nutrient agar jelly containing 2% of potato starch flour as nutrient material.

The agar was purchased in dehydrated form from the Digestive Ferments Company and had the following composition:

Beef Extract	3 parts
Peptone	5 parts
Agar-Agar	15 parts
Sodium Chloride	8 parts

For use, 31 grams were dissolved in 1,000 c.c. of distilled water by boiling.

The hot medium was poured into small test tubes and stoppered with cotton wadding. The tubes were placed at an angle of about 15° to the horizontal while the agar set, so that when cold the jelly had a fairly even large sloping surface.

As a check on the results obtained using the above medium, final tests were made using a pure size mixture as the medium. This paste was made up as follows:

Water	200.0 parts
Potato Starch Flour	25.0 parts
Tallow	5.0 parts
Caustic Soda	2.5 parts

When cold this mixture set to a reasonably solid jelly.

As a preliminary to the work on prevention of mildew, it was considered advisable to learn something about the fungi in question. To this end, cultures were made of various moulds found at hand. A liquid medium was found necessary for this work, hence a Raulin's Solution was made up composed as follows:

Distilled Water	1500.00 c c.
Cane Sugar	70.00 gm.
Tartaric Acid	4.00 gm.
Ammonium Nitrate	4.00 gm.
Potassium Carbonate	0.60 gm.
Ammonium Phosphate	0.60 gm.
Magnesium Carbonate	0.40 gm.
Ammonium Sulphate	0.25 gm.
Zinc Sulphate	0.07 gm.
Iron Sulphate	0.07 gm.
Potassium Silicate	0.07 gm.

This was sterilized and stored ready for use in sterile flasks.

The moulds of which cultures were made are as follows:

1. Black Mould.—Of which a pure culture was available.

2. Blue-Green Mould.—Found growing on a piece of old agar which had been exposed to the atmosphere of the laboratory.

3. White Mould.—Developed on a fresh nutrient-agar jelly in the laboratory.

4. Blue Mould.—Found on a piece of rotted apple.

5. Black Mould.—Developed on a piece of rotted burlap bagging when it was incubated in Raulin's Solution.

These mildews were studied under the microscope with the object of learning something about their nature, habits, methods of reproduction, etc. A description of the microscopic appearance of the Black Mould (No. 5) is given as a typical example:

Black Mould.—The mildew growth consists of a fine, wavy, branching network—Mycelium—whose individual

threads are about ½ small division in diameter* and consist of cells joined together at the ends. The individual cells are four to five times as long as broad. Branching from this network are stalks bearing the reproductive organs. These stalks are 1 to 3 small divisions in diameter, and terminate in spherical Sporangia, which are indented at the point of junction somewhat like a cherry. The diameter of these Sporangia is from 12 to 15 small divisions. They contain millions of minute spores, whose brown-black color gives the color to the whole. The spores are about 1/3 small division in diameter. These spores are scattered when ripe and are the seeds from which new growths develop. Reproduction seems to be asexual.

In the course of the study of moulds it became apparent that, lacking a rather extensive study of microbiology, it would be impossible to identify the fungi studied. For this reason it seemed rather foolish to try (even if it were possible) to carry on the experiments using several species of mildew in an effort to account for specific differences in toxicity; it was decided to select one typical mould for the tests. The black mould, being apparently the most abundant and the most prolific of the fungi at hand, was accordingly selected.

The method by which the tests were made was to add the antiseptic to the liquid medium, and when the slants were cold to innoculate them by transferring spores from a pure culture of black mould to the surface of the slant by means of a sterile platinum wire. The tubes were usually innoculated in duplicate and a blank control run along with them for comparison. They were then incubated.

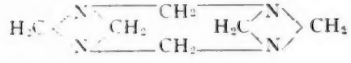
The first series of tests has been called Set A. It consisted of the following:

No.	Per Cent
1. Blank (Control)	...
2. Zinc Chloride	1.0
3. Boric Acid	1.0
4. Hexamine*	0.5
5. Thymol	0.1
6. Neomerpin	2.0
7. Neomerpin O	2.0
8. Hexalin (Soluble Oil)	2.0
9. Hexalin (Alcohol)	2.0
10. Resorcin	0.1
11. Benzoic Acid	1.0
12. Sodium Benzoate	1.0
13. 1-brom-2-naphthol*	0.2
14. 1, 6-dibrom-2-naphthol*	0.2
15. Blank (Control)	...

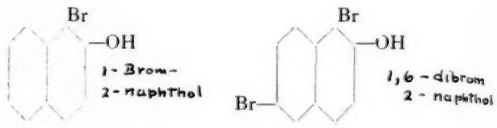
This set was innoculated with black mould and set to incubate on February 16, 1928. The numbers marked with an asterisk (*) are antiseptics which had to be prepared as they are not on the market.

*All of the measurements quoted in the above were taken with the disc micrometer using a 10x ocular, 16-mm. objective, and minimum tube length; giving a magnification of about 100x.

Hexamine (Urotropine, Hexamethylenetetramine) was prepared by mixing equal volumes of formaldehyde (40%) and ammonia (28%). The reaction is strongly exothermic, hence it is best carried out in a vessel cooled with ice. The dry product is obtained by evaporation of the mixture. The formula of Hexamine is $C_6H_{12}N_4$. Its structure is not certain, the following being an hypothetical formula:



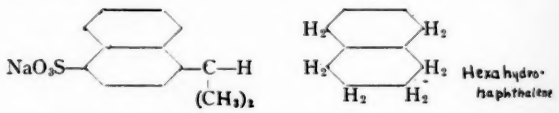
1-brom-2-naphthol was prepared in the following manner: To 7.2 gm. b-naphthol dissolved in glacial acetic acid was added slowly with stirring a solution of 2.7 c.c. bromine in five times its volume of acetic acid, and the mixture let stand one-half hour. On diluting the acetic acid with water the product was precipitated out, and after standing overnight was filtered off. 1-brom-2-naphthol forms colorless needle-like crystals, has a faint but penetrating aromatic odor, and melts at 84° C.



1, 6-dibrom-2-naphthol was prepared in a similar manner by using twice as much Bromine. Its properties are very similar to those of the monobrom product. Melting point 106° C.

An attempt was made to prepare *1, 3, 4, 6-tetrabrom-2-naphthol*. The necessary amount of Bromine was added to the glacial acetic acid solution of the b-naphthol and the mixture heated at the boil under a reflux condenser for one hour. Upon dilution of the acetic acid the product came out of solution as an amorphous mass and no effort at crystallization was successful. Theoretically it should give needle-like crystals from ligroin (Petroleum ether). At attempt to crystallize the product from acetone gave rise to a brominated acetone which had an intense lachrymatory action. The attempt to prepare this compound was subsequently abandoned.

Neomerpin O is Naphthalene Iso-propyl Sulphonic acid Soda salt. It is noted for its wetting and penetrating properties. It is faintly acid to sensitive indicators.



Neomerpin is principally Naphthalene Iso-propyl Sulphonic acid Soda salt but contains in addition some Hexalin and Tetralin. Its properties are similar to those of Neomerpin O.

Hexalin and *Tetralin* are hexa- and tetra-hydro naphthalene, respectively.

Set A was examined after four days (Feb. 20, 1928) and the following tubes were seen to have developed mildew:

No.	Per Cent
1. Blank	...
4. Hexamine	0.5
10. Resorcin	0.1
12. Sodium Benzoate	1.0
15. Blank	...

All of the others remained sterile.

After twelve days (Feb. 28, 1928) the set was again examined and the following additional tubes showed mildew growth:

No.	Per Cent
3. Boric Acid	1.0
8. Hexalin (Soluble Oil)	2.0

The growth on the tube containing Hexalin dissolved in soluble oil (No. 8) was so slight as to leave some doubt as to whether there was any growth at all.

Another examination of Set A after twenty-one days (March 12) showed that, in addition to the above, the following tube showed mildew growth:

No. 2. Zinc Chloride	1.0%

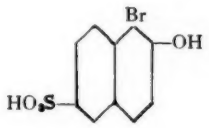
The growth on this tube was rather slight.

The other tubes still remained sterile, namely, No. 5, Thymol, 0.1%; No. 6, Neomerpin, 2.0%; No. 7, Neomerpin O, 2.0 %; No. 9, Hexalin (alcoholic solution), 2.0%; No. 11, Benzoic Acid, 1.0%; No. 13, 1-brom-2-naphthol, 0.2%, and No. 14, 1, 6-dibrom-2-naphthol, 0.2%. These antiseptics are, apparently, the most toxic of those tested in this set. In all cases the amounts of antiseptic used were those recommended by previous workers, if any, or in the case of the brominated naphthols, figures assumed from the quantity recommended for straight b-naphthol.

The results of Set A seem to indicate that the brominated naphthols have considerable antiseptic value. They are, however, insoluble in water; and in these tests were used in alcoholic solution. They can be dissolved in water with caustic soda similarly to the naphthols themselves forming the sodium salt. This soda salt, however, behaves in a peculiar manner when added to a size mixture: on exposure to light the 1-brom-2-naphthol soda salt develops or causes to be developed a deep red-brown color. This coloration was noticed only on the side of the tube which was exposed to direct daylight, and was directly proportional to the amount of bromnaphthol soda salt in the tube. At the surface of the slant where light and air acted upon the substance simultaneously, a deep blue-black coloration developed which extended into the material to a depth of about 3/16 inch. The coloration was not noticed in tubes containing the straight bromnaphthol. This production of deep color is obviously a very serious drawback to the use of the bromnaphthol soda salt in size mixtures. The well-known fact that naphtholates sublime off rather readily when exposed to moderately high temperature would be another objection to the use of this substance. The simple 1-brom-2-naphthol would, of course, be disqualified by reason of its insolubility.

In view of the above facts it was decided to try to prepare a compound involving the bromnaphthol nucleus which would be soluble in water and also eliminate the objectionable features of the naphtholates. The compound decided upon was the sulphonic acid.

The sulphonation was carried out by treating a portion of the 1-brom-2-naphthol with an equal amount of concentrated sulphuric acid and heating on the boiling water bath for one-half hour. At the end of this time the sulphonation mixture was allowed to cool and then poured into water, whereupon it dissolved almost completely with a light brown color. The solution was heated to 80° C. and saturated with salt. After cooling the precipitated substance was filtered off. The product thus obtained was odorless, light brown in color, and readily soluble in water. Its structure might be as follows:



In order to test the antiseptic value of this sulphonated compound a set of nutrient-agar slants was made up containing various amounts of the substance. This was called Set B:

No.	Per Cent
1. 1-brom-2-naphthol-6-sulphonic acid	0.1
2. 1-brom-2-naphthol-6-sulphonic acid	0.2
3. 1-brom-2-naphthol-6-sulphonic acid	0.3
4. Blank (Control)	...

Set B was innoculated on March 7, 1928, with Black Mould and set to incubate. Five days later, March 12, examination of this set showed that all of the tubes had developed considerable mildew growth.

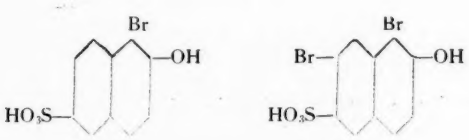
The results of Set B were so different from what had been expected that some doubt arose as to whether or not the bromnaphthol had been de-brominated during the process of sulphonation (although, as a matter of fact, this is very unlikely). In order to check up on this the "Beilstein Test" for halogens in organic compounds was tried.

This test consists of heating a piece of copper oxide (wire form) in a gas flame until the flame is colorless except for a slight copper color, then thrusting the still hot wire into the substance to be tested (dry) and then back into the flame. A bright violet, blue, or green color indicates the presence of halogen, and the duration of the color gives a rough indication of the amount present—whether accidental or combined.

By this test bromine seems to be present in substantial quantity. Nevertheless, it was decided to attempt a synthesis of the same product, or an isomer, by a different method.

Instead of sulphonating bromnaphthol, this method consists of brominating Schaeffer's acid (2-naphthol-6-sulphonic acid). A mono- and a di-brom product were prepared.

To one mol of Schaeffer's acid dissolved in caustic soda solution were added 1 or 2 mols (as the case happened to be) of Bromine dissolved in 2 (or 4) mols of caustic soda. The mixture was stirred mechanically and a sufficient amount of hydrochloric acid added from a dropping funnel to slightly more than neutralize all the caustic soda present. This liberated free Bromine and free Schaeffer's acid in the presence of each other, under which circumstances they should readily combine. The product was salted out in the usual manner. The monobrom product closely resembled the 1-brom-2-naphthol-6-sulphonic acid previously prepared and probably was the same. The dibrom product was darker in color but otherwise had about the same properties. In both cases a considerable amount of unchanged Schaeffer's acid remained after the process.



These products were tested for antiseptic value against mildews by means of agar slants containing varying amounts of the compounds being tested. The result was called Set C.

No.	Per Cent
1. Blank (control)	...
2. Monobrom Schaeffer's Acid	0.1
3. Monobrom Schaeffer's Acid	0.2
4. Monobrom Schaeffer's Acid	0.3
5. Dibrom Schaeffer's Acid	0.1
6. Dibrom Schaeffer's Acid	0.2
7. Dibrom Schaeffer's Acid	0.3
8. 1-Brom-2-Naphthol-6-Sulphonic Acid	0.2
9. Blank (control)	...

This set was inoculated with black mold on March 15, 1928, and set to incubate. After four days, March 19, the set was examined. All of the slants showed considerable mildew growth. These results seem to indicate that the products obtained as a result of the attempted bromination of Schaeffer's acid had, under the conditions prevailing and in the concentrations used, no antiseptic value.

In order to more fully establish the last-mentioned point, the bromination of Schaeffer's acid was run once again and the resulting compound purified by re-crystallization. A set of agar slants was made up and antiseptic added as follows—Set D:

No.	Per Cent
1. Blank	...
2. Zinc Chloride	1.0
3. Strontium Chloride	1.0
4. Neomerpin	2.0
5. Neomerpin O	2.0
6. Hexalin (Alcohol)	2.0
7. Hexalin (Soluble Oil)	2.0
8. Brom Schaeffer's Acid	0.5
9. Brom Schaeffer's Acid	1.0
10. Blank	...

Set D was inoculated on March 28, 1928, with black mold and set to incubate. The three compounds Neomerpin, Neomerpin O and Hexalin were included in this set as a check on previous results, zinc chloride was included as a standard and strontium chloride merely out of curiosity—it is closely allied to zinc chloride according to the periodic arrangements of the elements, and might possibly be an antiseptic.

On the following day the set was examined and the following tubes were seen to have developed mildew:

No.	Per Cent
1. Blank	...
3. Strontium Chloride	1.0
8. Brom Schaeffer's Acid	0.5
9. Brom Schaeffer's Acid	1.0
10. Blank	...

On April 2 Set D was again examined. At this time mildew growth could be discerned on all of the tubes. The growth on tubes Nos. 4 and 5 (Neomerpin and Neomerpin O) was very slight; and subsequent observations of this set showed that this mildew growth remained at a standstill, while on the other tubes it flourished. It seems that Neomerpin and Neomerpin O do not take effect until the mildew has started to grow; then they arrest or very materially retard it before it has a chance to do any damage. It must be borne in mind also that the conditions under which these tubes were incubated were ideal for the growth of mildew—probably more severe than any conditions which would be encountered in actual practice.

After these three trials, the bromnaphthol sulphonic acids were abandoned and attention was focused on more promising material—Neomerpin and Neomerpin O.

Set E had a twofold object: First, a photographic record of the method of making the tests was desired, and, second, there was the possibility that an increase in the amount of Neomerpin or Neomerpin O used might result in increased toxicity to be considered. Accordingly, this set was made up and photographs taken after various intervals of time.

SET E

No.	Per Cent
1. Blank (control)	...
2. Zinc Chloride	2.0
3. Nomerpin	2.0
4. Neomerpin	3.0
5. Neomerpin O	2.0
6. Neomerpin O	3.0
7. Blank	...

This set was inoculated with black mold on May 1, 1928, and set aside to incubate. The next day (May 2) the controls already showed some mildew growth (see Plate I). After six days (May 7) examination of Set E showed that mildew had made some growth in all of the tubes. In this set, however, the difference between the mildew on slants containing Neomerpin and Neomerpin O and one containing zinc chloride, for example, was even more noticeable than in Set D. In this case the growth on tubes Nos. 3, 4, 5 and 6 was so slight as to be hardly perceptible. Apparently the mildew had barely had time to start before its development was arrested. Yet, under the same conditions, the tube containing zinc chloride in twice the concentration generally used showed a very considerable growth of mold (see Plate II). Another examination of Set E after ten days showed that on the tubes containing Neomerpin and Neomerpin O mildew had made no further growth, whereas on the blanks and on the tube containing zinc chloride a considerable increase had taken place (see Plate III).

Set E also showed that the toxic concentration of Neomerpin and of Neomerpin O is 2% or lower. The tubes in this set containing 3% of these substances showed no greater resistance to mildew growth than those containing 2%.

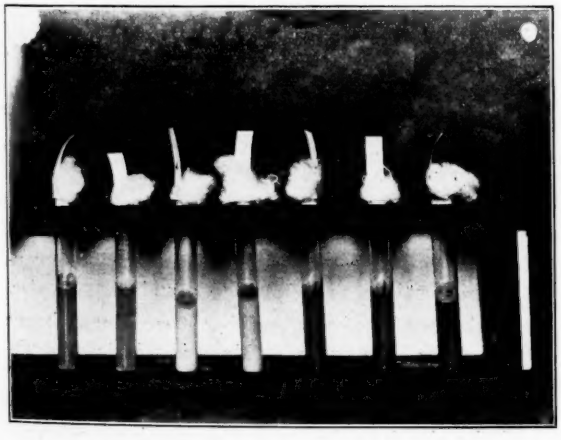


FIG. 1—*Set E, Incubated Twenty-four Hours*

This illustration shows how the medium containing the antiseptic was put into the tubes, which were then inoculated. In the first and last tubes (controls) the beginnings of mildew growth can be seen as a lighter colored layer on top of the medium. The other tubes show only inoculation marks—small black markings on the upper surface of the medium.

As conclusive proof of the superior toxicity of Neomerpin and Neomerpin O toward mildews, the results of a set which was inoculated before any of the others, and

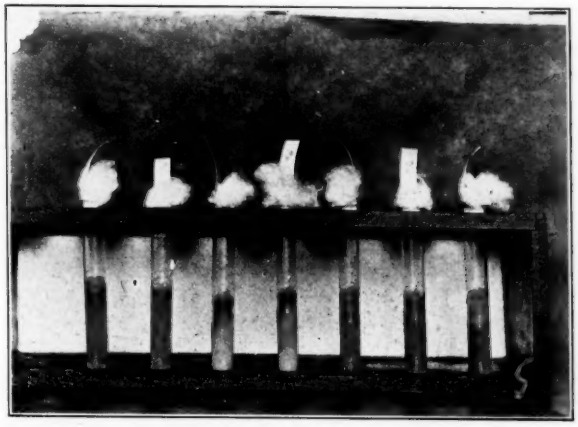


FIG. 2—*Set E, Incubated Six Days*

The growth of the control tubes (Nos. 1 and 7) has noticeably increased, and considerable growth can be discerned on No. 2 (zinc chloride). A light colored ring will be noticed surrounding the black dots on the surfaces of the mediums in tubes 3, 4, 5 and 6. This is the beginning of mildew growth. As can be seen, it is very slight. The shiny appearance just below the top of the medium in most of the tubes is light reflection, due to the medium having contracted away from the glass. Bubbles can be seen at the surface of the medium in tube No. 5; this should not be confused with mildew growth.

which has been called Set AA, will now be given. Set AA was made up as follows:

No.	Per Cent
1. Hexalin (Soluble Oil)	2.0
2. Control	...
3. Neomerpin	2.0
4. Control	...
5. Neomerpin O	2.0
6. Control	...

These tubes were inoculated with black mold on January 12, 1928, and set aside to incubate. The conditions under which they were incubated were at first not quite as severe as those prevailing later, but after some time had elapsed the humidity was raised and they were incubated under the same conditions as Sets D and E. Tube No. 1 of Set AA (Hexalin) developed a luxurious growth of mildew within a short time, as did also the controls, tubes Nos. 2, 4 and 6. Tubes Nos. 3 and 5, however, showed great resistance to mold growth, especially in the case of Neomerpin (No. 3), which showed no sign of mildew even after three months (April 26).

In view of the results of the tests for toxicity quoted above, it became apparent that if Neomerpin and Neomerpin O conformed to the other requirements of a satisfactory textile antiseptic, they would be worthy of recommendation as such. Accordingly, tests to determine their fitness along these lines were undertaken. The results of these tests are set forth below. These tests fol-

low in order according to the ten requirements quoted in the introduction.

1. Neomerpin O readily dissolved in water with a pale straw to brown color, depending upon the concentration. Neomerpin dissolves as a milky emulsion. This substance contains some Hexalin and Tetralin, which are both insoluble in water; hence, Neomerpin O itself apparently acts as an emulsifying agent.

2. Neomerpin O is non-volatile with steam, whereas Neomerpin loses its Hexalin and Tetralin on being distilled with steam. Both substances are stable to heat.

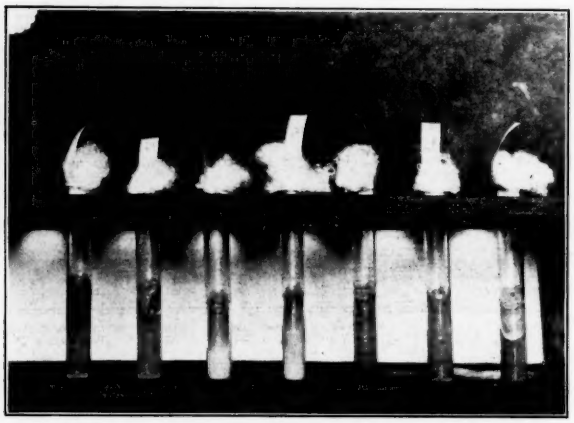


FIG. 3—*Set E, Incubated Ten Days*

From this illustration it can be readily seen that while mildew has flourished on the controls (Nos. 1 and 7) and on the tube containing zinc chloride (No. 2), it is at a standstill on the other tubes containing Neomerpin and Neomerpin O.

3. Neomerpin O has only a pale color in solution, while Neomerpin is milky white. Neither imparts any color to the size or fabric.

4. Neither of these substances has any appreciable odor in the concentrations used.

5. These materials have no tendering action on cloth.

6. Rather than having any deleterious effect on the dyeing or finishing operations, these substances would tend to assist them. They are put on the market and used rather extensively as dyeing assistants, as they assist the penetration and levelness of the dye.

7. Although slightly acid to sensitive indicators, Neomerpin and Neomerpin O have no action on metals, wood or other materials, hence would not harm any parts of machinery with which they might come into contact.

8. The manufacturers of Neomerpin and Neomerpin O claim that these products are non-poisonous and safe to handle. No special tests were considered necessary.

9. It was considered possible that the addition of Neomerpin or of Neomerpin O to a size mixture might in some way alter the properties of the starch so that it would not give the required strength to the yarn. To decide this point, size mixtures were made up with and without the addition of Neomerpin O, yarn sized with these mixtures, and the sized yarn tested for breaking strength.

The sizing pastes had the following composition:

Water	1,250.0	grams
Potato Starch Flour	224.0	"
Tallow	20.0	"
Caustic Soda (76° Tw.)	2.7	"

The yarn was sized by immersing it in the boiling size mixture and turning it several times, removing, squeezing and repeating the operation. The yarn was then dried.

The results of the tests for breaking strength are tabulated below:

	Unsized Yarn	Plain Size	Size and Neomerpin O
1	4.73	7.38	6.98
2	4.77	7.60	7.75
3	5.31	7.31	7.99
4	5.36	8.02	7.74
5	5.60	7.46	7.80
6	5.21	7.67	7.60
7	5.00	7.22	7.34
8	5.03	7.55	7.07
9	5.30	7.40	6.99
10	5.33	7.48	7.11
11	5.30	8.50	7.61
12	5.09	7.80	6.42
13	4.69	7.70	7.69
14	5.42	8.23	6.82
15	5.20	7.60	7.52
16	6.12	7.60	6.98
17	5.89	7.63	6.67
18	5.90	7.42	7.47
19	5.81	7.57	7.60
20	5.44	6.13	7.42
21	5.78	7.20	8.00
22	5.50	7.52	7.73
23	5.71	...	7.98
24	5.71	...	7.48
25	6.19	...	...
26	5.21	...	...
Averages	5.41	7.55	7.41

On analysis the plain sized yarn was found to contain 22.54% size, and the yarn sized with the mixture containing Neomerpin O was found to contain 19.86% size.

From the results of the breaking-strength tests it can be seen that the Neomerpin O did not impair the strengthening properties of the size. No difference in feel could be discerned between the two sized yarns. The penetration of the size into the yarn was examined under the microscope by means of cross-sections of the yarn sized with the mixture containing Neomerpin O. The cross-sections were stained with iodine. By showing up a deep blue color wherever it came into contact with starch, the

(*Continued on page* 543)

Proceedings of the American Association of Textile Chemists and Colorists

The American Association of Textile Chemists and Colorists

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SUMMER MEETING OF THE PIEDMONT SECTION

THE summer meeting of the Piedmont Section of the American Association of Textile Chemists and Colorists was held at the George Vanderbilt Hotel in Asheville, N. C., Saturday, July 21, 1928.

The business meeting was held at 3.30 p. m., about one hundred members being present. This meeting was followed by a banquet at 7.30. The Cliffside Band of the Cliffside Mills, Cliffside, N. C., entertained during the banquet. In the absence of other officers the meeting was conducted by the secretary.

The following interesting papers were presented: Burton F. Mitchell, superintendent of the mercerizing plant of the American Yarn and Processing Company, Mount Holly, N. C., presented "Preparation of Yarn for the Knitter."

Prof. Thomas Nelson, Dean of Textiles of the North Carolina State College of Agriculture and Engineering, Raleigh, N. C., presented "Research and Testing at North Carolina State Textile School."

Robert W. Griffith, of the Champion Fiber Company, Canton, N. C., presented "The Forest and Industry."

Thomas J. Nuckolls, of the Piedmont Plush Mills, Greenville, S. C., presented "Processing Cotton Pile Fabrics."

A committee for nominating officers was appointed as follows: Arthur Thompson, chairman; R. H. Souther, and Harry Ormand.

The next meeting is to be held in Charlotte, N. C., about the middle of October, and will be the annual meeting. The officers for the year will be elected at that time.

DYER S. MOSS, *Secretary.*

The Preparation of Yarn for the Knitter*

By BURTON MITCHELL

Superintendent of Mercerizing Plant of the American Yarn Processing Co., Mount Holly, N. C.

WHEN your committee asked me to write an article on the "Preparation of Yarn for the Knitter," it immediately occurred to me that this could apply to all the yarns made from the different fibers—cotton, wool, silk, rayon, etc., but as my experience has been limited to the manufacture and mercerization of cotton yarns, it

*Paper presented at the Summer Meeting of the Piedmont Section, held in Asheville, N. C., July 21, 1928.

will be necessary to confine my remarks to that particular fiber.

The actual manufacture of cotton yarn is just as important as the mercerizing, or finishing, process. It has been said that mercerizing and dyeing begins in the card room. I agree with that statement to a certain extent, but I would modify it by saying that those two processes begin with the selection of the cotton. The grade, staple, and character of the cotton selected determine to a great extent the quality of the yarn, but of course the subsequent processes in spinning effect the smoothness, elasticity, and uniformity of size and twist, all of which are important factors after the yarn has been turned over to the finisher.

The mercerizers who manufacture their own yarns, or who have regular sources of supply of a constantly uniform product, have a distinct advantage over those who buy their yarn at random. Co-operation between the mercerizing plant and the spinning plant plays a highly important part in the successful production of mercerized yarns.

I might go into the mechanical details of the actual spinning of the yarn, but the subject would require so much of my time that it is necessary to make another limitation in my article, and that is, to deal solely with the mercerizing and aftertreatment of cotton yarns.

Two Major Considerations

The knitter has two major considerations in the selection of mercerized yarns of a quality that will produce economically a type of goods that will satisfy the market of to-day. He desires a yarn that will run well on his machines with a minimum of waste, and a yarn that will dye uniformly, and show a good luster in the finished goods. As I have stated before, spinning plays an important part in producing a yarn of this type, but since deciding to narrow the subject down to mercerizing, we will take it for granted that the mercerizer is receiving an average yarn, and proceed from here with the actual process of mercerization.

Mercerizing derives its name from John Mercer, an Englishman who took out the first patents on the process about 1850. At that time Mercer was experimenting with the treatment of cotton cloth with caustic alkalies to produce a crimping, or crepe, effect with an increased affinity for dyestuffs. He did not specify in his patent the use of tension, nor the necessity of using goods made from long staple cotton, two particular factors essential in producing a high luster on mercerized goods. Mercer died in 1866 without realizing the possibilities of the process which he first started. After Mercer came H. A. Lowe, Richard Thomas, and Emanuel Prevost, all of whom contributed very materially to the advancement of the process.

Mercerizing according to our modern standards did not become a commercial success until 1898, and the process was developed simultaneously in England and this country. Since mercerizing was first established as a practical branch of the textile industry very few changes have been made in the actual process. Of course, we now have much more efficient machinery to insure proper mercerization. Other improvements are the pretreatments and aftertreatments with chemicals and oils—an introduction of the past ten or twelve years—all of which I will discuss later in this article.

The modern mercerizer desires to produce a finished yarn that is uniform in structure, pliable, of a good luster, with an increased affinity for dyes, and having a high breaking strength. There are many finishers who are producing a product that will come up to the above qualifications, but it is interesting to note that they are using many and varied treatments to get the same results.

The chemical composition of the cotton fiber is similar to most of the other vegetable fibers, and consists chiefly of cellulose, which is coated with a layer of wax and oily matter, and more or less pigment. The first problem of the mercerizer consists in the method to be used in the treatment of the waxes, oils, and other impurities on the fiber so that the concentrated caustic solution will come in direct contact with the pure cellulose. The direct contact, or penetration, of the fiber is necessary before a product can be produced that will show a uniform luster, or dye evenly.

Treatment with Waxes and Oils

There are at least two different methods used in treating the waxes and oils. One treatment consists in giving the yarn a thorough wetting-out in plain boiling water, or in some instances with the addition of some penetrating agent that will assist in opening up the yarn and softening the waxes and oils. This method does not remove the waxes and oils, but makes the yarn more absorbent of the caustic. Dirt and other foreign matter is removed by the boiling water. The second treatment consists in the emulsifying of the oils and waxes by the use of a chemical agent, and holding them in suspension until they can be removed. Theoretically, this method gives a pure cellulose fiber for direct contact with the caustic bath. However, a large per cent of the mercerizing in this country is done on warp ranges, and as the period of detention in the boiling boxes is so limited it is quite possible that in some instances the oils and waxes will be emulsified without removal from the yarn. If this should be true, instead of assisting the mercerization it would be hindered by the retention of the oils and waxes on the

yarn. This question of pretreatment is a fine one for discussion, as there are good arguments pro and con.

After preparation and before going into the concentrated caustic (where the actual mercerizing takes place) the yarn must be run through cold water, as the temperature of the caustic bath is one of the three vital factors in producing a soft, lustrous yarn. The temperature of the caustic bath should be kept below 70° F. at all times, or there is a possibility of the finished product being harsh and discolored, two defects which no knitter would ever overlook.

The next factor is the strength of the caustic, which must be kept the same throughout the process, as the action of caustic soda on the cellulose fibers varies with the different degrees of strength. This would bring about a condition which is generally termed uneven mercerizing, and that in turn causes uneven dyeing.

The third element to consider is the amount of tension under which the yarn is kept during the action of the caustic. Mercerizing in reality is the chemical action of caustic soda on cotton fibers under tension, with the tension being the mechanical means of producing a luster. Cotton fibers could be mercerized without tension to produce an increased affinity for dyestuffs and an increase in breaking strength, but they would not attain a silky luster.

When the cotton fibers are penetrated by concentrated caustic they undergo a peculiar physical change. The inner cells, which appear to absorb the alkali, begin to swell at once, pressing on the outer walls and changing the ribbon-like shape to a cylindrical form so that it has a hairlike appearance, and becoming somewhat translucent to light, although still firm in structure. The fiber also begins at this point to untwist itself, and if permitted to do so, it would shrink considerably in length, but by keeping the tension on both ends the shrinkage is prevented and consequently the swollen inner cells smooth out all the convolutions on the surface, causing it to become smooth and even—capable of reflecting light with but little scattering of the rays. In summary: the swelling, untwisting, change in structure, and the mechanical prevention of shrinkage in the cotton fiber, all accomplished by the treatment with concentrated caustic soda, give us the product which is known as mercerized yarn.

Removing the Alkali

After the actual mercerizing takes place it is necessary to remove the concentrated alkali from the yarn, and this is done by washing with water and souring with sulphuric acid while the yarn is still under tension. The tension being required until all the alkali has been neutralized by the acid to prevent the possibility of shrinkage which would dull the luster. The proper strength of the acid to be used is determined by the amount of caustic left in the yarn, which in turn is regulated by washing.

Following the souring process the yarn must be thoroughly washed, as any caustic or acid left in the yarn would eventually bring about deterioration of the fibers.

Another treatment and one on which all mercerizers do not agree is the aftertreatment with oils or chemicals to lubricate or soften the yarn. Many mercerizers use for this purpose such substances as vegetable oils, mineral oils, tallows, waxes, and various chemical combinations. Some use only a volatile alkali to neutralize any excess acidity and finish off with a warm water bath.

The main types of oils or greases are mineral, vegetable and animal, and as these are bases for most all the softeners and lubricants it is unnecessary to take up the chemical combinations. It is a recognized fact that a mineral oil is the best lubricant for anything, ranging from machinery to yarn, but it is considered by competent dyers as being dye resistant, and necessarily would have to be removed entirely before the yarn could be dyed uniformly. Vegetable oils are dye assistants, but are not so good as lubricants, and they are very likely to become rancid with age.

There are probably many good dyers in this audience who could discuss this subject of aftertreatment and its effect on dyeing with more authority, and as this is in reality a problem more pertinent to the dyer than to the mercerizer, I will not discuss it further.

Breaks Mean Costly Waste

Even when all of the processes that have been mentioned have been carried out to perfection it is still possible to ruin the yarn as far as the knitter is concerned. The care with which the yarn is put up and packed determines to a large extent the percentage of waste production on the knitting machine. I mean by this that it is possible to have perfect mercerization, and yet in the subsequent processes of quilling and winding to handle the yarn in such a manner that the resulting package will not meet the knitters' demands.

It is absolutely necessary to use the utmost care in handling all yarns going to a knitting machine, because a few breaks mean a loss in production, broken needles, and expensive waste.

In the preparation of yarn for the knitter, the mercerizer must strive to produce a finished product that shows good mercerization and careful winding and packing. The one without the other would not meet the modern knitters' demand for a well-finished mercerized yarn. Were we to consider the mercerization as 50 per cent and the subsequent disposition as the remaining 50 per cent to produce a 100 per cent perfect yarn, the im-

portance of the two—mercerizing and afterhandling—could be appreciated.

A mercerizer could not grade his product with the same composure as was once exhibited by a certain history professor in grading the examination paper of a popular athlete. This athlete was captain of the football team and the star player, but his ability being more outstanding on the football field than in the classroom, he had flunked history examination just before the Thanksgiving game, and consequently had been barred from playing. Some of the coaches entreated the professor to give the boy another chance, and finally after considerable persuasion the professor gave the boy another exam and passed him on the course. The boy played brilliantly in the Thanksgiving game, and was responsible for a victory for alma mater. After the game was over, one of the coaches thanked the professor for giving the boy another chance, and remarked that he had entertained serious doubts as to the player passing a second test. The philosophical old professor said that as a rule he gave ten questions on an exam, each one counting ten points, with seventy as a passing mark, but that in this "peculiar" instance he gave only two questions, each counting fifty points, with fifty as a passing mark. The first question was: "When was America discovered?" The answer came back, "1632." The professor marked down a zero. The second question was, "When was the first settlement made on the North American continent?" The player answered, "I do not know"—and the professor marked down a fifty.

Research and Testing at the Textile School*

By Prof. Thomas Nelson

Dean of Textiles, North Carolina State Textile School

MR. CHAIRMAN, Members of the Textile Chemists and Colorists' Association: Research is a comprehensive subject and of much importance to the textile industry to-day. The dictionary gives several definitions of research, such as "To search again and anew" or, in other words, a re-search; "diligent and protracted investigation," "studious and laborious inquiry," and other definitions. Large manufacturing companies such as the General Electric Company, the Bell Telephone Company and others have found that research conducted in their industrial laboratories has contributed to the improvement of their product and, I believe, to their financial success. Many illustrations can be given of the value of a research laboratory, as it affects a particular business. In many cases the results obtained through application and concentration of thought not only benefits an industry but is also a direct public beneficiary.

*Paper presented at the Summer Meeting of the Piedmont Section, held in Asheville, N. C., July 21, 1928.

How Research Has Solved Industry's Problems

Every branch of every industry has scientific problems to solve. This is particularly true of the textile industry. Yet this industry has a background of scientific history that is creditable. True, research has not developed here as much as in some others, but think for a moment what has been done.

Beginning with ginning and the development of the gin by Whitney; hand spinning and the development of spinning; hand weaving and the development of the loom; also the development and improvements over the old methods of dyeing and finishing. With each increase in production because of development of machinery, improved methods have been required to keep pace with production, so that the old adage is still true that "Necessity is the mother of invention," and I would add also of "research."

Rayon, one of the wonders of the age, unknown a comparatively few years ago, has developed into a world wide industry and is a field for further scientific investigation.

I believe I am safe in saying that textile progress during the past twenty-five years is the direct result of research, but what lies ahead of us? With all that has been done, there is still a tremendous amount of work yet to be accomplished. There are unsolved problems on every hand occurring again and again that require fundamental research.

Take, for example, a cotton boll, the foundation of the largest industry of the South. A boll consists of thousands of individual fibers, in every case of different lengths, and very often of different maturity in the same boll. Yet this cotton is taken from the boll and put through a series of machines—scientific processes—and made into yarns and fabrics. All of which is the result of research and experimentation. But there are still many unsolved problems in connection with the processing of cotton. For example: What effect does "drag" in cotton have on the strength of yarn? What relation has spirality of cotton to breaking strength of yarn? how much does maturity of fiber, or the development of the cell wall, affect the strength of the fiber and later the yarn? And what of the numerous problems connected with the affinity of dyes as they affect cotton and yarn, and of others too numerous to mention, to say nothing of the larger problems of the industry as a whole?

But I have digressed somewhat, as I was not asked to discuss the need of research in the textile industry, but to tell you something of the work being done at the Textile School of North Carolina State College and of the aims of that institution.

The Textile School has an excellent equipment of machinery for the instruction of young men in the art and

science of cotton manufacturing, which includes textile chemistry, bleaching, dyeing and rayon; the school also has silk throwing and knitting equipment.

In addition to this equipment, which is used primarily for instruction purposes, the college has provided a complete experimental cotton mill with regular commercial machinery of the latest type which will permit a wide range of operations. This mill is equipped with the latest automatically controlled humidifiers so that humidity can be controlled and tests conducted under comparable mill conditions. I might say that this is the only textile school in the country, so far as I know, to have such an experimental laboratory. This and other laboratories in the textile school are placed at the disposal of any mill or individual who desires to use them for the purpose of research and experimentation.

The School Research Laboratory

During the present school year an additional research laboratory was established and equipped for the study of rayon, starches, sizes, dyes and also for photo-micrography. The equipment in this room has been selected with a view to the needs of research in this particular line of work and is as follows: LaMotte Roulette Comparator for determining pH values; Bausch and Lomb Photomicrographic Outfit; Microtome for obtaining cross sections; Microscope accessories such as Silverman Illuminator; Abbe Camera Lucids; Student Ocular Lamps, etc.; Kennicut Hurley Colorimeter; Kjeldahl Outfit for Determining Nitrogen; Electric Ovens; Electric Stirring and Shaking Apparatus; Orsat Gas Apparatus for Testing Flue Gases; Cleveland Open Cup Oil Tester for Flash and Fire Points of Oils; Alexander Glue Tester for Viscosity Tests; Scotts Viscosimeter for Oils, etc.; Westphal Balances to Determine Specific Gravity; Analytical Balances; Babcock Separator; Glassware and Supplies; Water Baths; Hot Plates, etc.

For a study of fibers, yarns and fabrics and to make tests on these materials another laboratory has been established at the school. The equipment consists of the latest machines used for this purpose and is as follows: Suter Cotton Stapler; Roving Reel; Cotton Yarn Reel; Silk Yarn Reel; Yarn Balance; Quadrant Yarn Balance; Yarn Inspector; Twist Counters; Single Thread Tester; Micrometer; Power Yarn Breaking Machine with Autofiraphic Recorder; Power Cloth Breaking Machine with Autographic Recorder; Crimp Tester; Mullen Tester; Emerson Conditioning Oven; Portable Humidifier.

Co-operation with the Industry

During the past year the Textile School has been called upon to assist mills in solving some of these problems. Many tests have also been made for mills, a list of these tests being given below:

Work Done for Mills at the North Carolina State College Textile School Since September 1, 1927

Comparison of strength and quality of different samples of knit goods, yarns made by yarn mill and made into men's knitted underwear.

Comparison of dye on yarn.

Analysis of imported sheeting.

Analysis of Indigo Paste to find per cent of Indigotine.

Allowable percentage variation in Indigo Paste.

Chalk marks on cotton, to determine whether or not these can be removed in bleaching.

Test on alcohol dye solution to determine volume of alcohol in solution.

Test to determine presence of injurious ingredients in slasher preparations on yarn.

Viscosity tests on starch.

Test to determine variation in counts of yarn.

To determine class of dye in hosiery.

Breaking strength of chambray used for men's shirts.

To determine reason for formation of scum in dyeing liquor.

Testing gingham fabrics for breaking strength.

To determine removability of chalk stains on cotton skeins previously treated with and without spray method of preparation.

To ascertain breaking strength, size, evenness, and elasticity on nine samples of yarn.

To determine cause of cloudiness in black dyed cloth.

To obtain construction, breaking strength and elasticity on cloth used for special purpose.

To try to remove black marks by practical mill method and determine cause of streaks in knit goods made from yarn submitted.

To determine presence of cotton in linen goods.

Spinning tests on Mexican Big Boll and Acala Cottons.

Breaking tests on 22 samples of mercerized yarn ranging from 16/2 to 100/2.

Grading and stapling cotton samples.

To determine breaking strength of bunting fabrics.

To determine purity of paraffin.

To secure proper chemicals to dissolve the scale formed, by use of peroxide, on bronze pipe.

To identify materials used in obtaining special finish on special cloth.

Stripping color from cotton.

Analysis of sizing tallow.

To determine breaking strength of fabric for export.

It is the desire of the Textile School to render assistance

to the textile industry and to co-operate in helping solve their problems, both by research and testing.

Fellowships

It is a pleasure to tell you that the president and trustees of State College recognize the value of research to the textile industry: Two fellowships have been awarded by them to the Textile School for the next school year which will enable the school to undertake more research and investigational work.

We are looking forward confidently to such associations as yours for co-operation in this work, and we will be glad to have suggestions from any of your members at any time.

Again let me call your attention to the fact that the laboratories at the Textile School of North Carolina State College are a your disposal, to be used by you or others engaged in the textile industry at any time.

It is our earnest desire that full advantage be taken of this, and that we, the faculty of the Textile School, may have the privilege and pleasure of co-operating with you in the development of the textile industry.

Processing Cotton Pile Fabrics*

By Thomas J. Nuckolls
Piedmont Plush Mills, Greenville, S. C.

PROCESSING of cotton pile fabrics is a comparatively new industry in the South to-day. In my paper I intend to give a brief outline of its manufacture, starting with the weaving and going through to the finished product. I do hope that the subject will be of interest to everyone here. Due to the brief time I will touch only lightly on the weaving and finishing of this fabric and put greater stress on the dyeing, of which we are all mostly interested.

History of Pile Fabrics

Pile fabric originated in China a thousand or more years ago. It was woven by hand, the filling making the pile. This was done by flat wires or wood laying in the loom warp-ways, the filling passing over these wires and the warp binding same. After the goods were woven the loops were then cut by a knife, making the pile. These goods were called Oriental rugs, with which we are all so familiar. The Persians then copied the Chinese invention, making rugs out of very fine yarn. This manufacturing process passed on to the Armenians, and later to the Syrians. When the Turks captured Asia they took this invention from the inhabitants and made Oriental rugs of fine Angoria hair that are known the world over. The Turks monopolized the Oriental rug market for many years.

During one of the early wars between England and Turkey a textile engineer in the British Army copied this loom and took it back with him to England. This Turkish hand loom was converted into a power loom, using very small wires running the filling way. This wire would pull out automatically at every pick, leaving very fine loops on the face of the carpet, which afterwards became known as Brussel carpets or rugs. A loom of this kind was used for a number of years until a man by the name of Wilton took it over. He placed a small knife on the end of each round wire; as these knives were drawn out from under the loops, the loops were cut, thereby making the pile. This rug became known as the Wilton rug, with which we are all familiar.

The loom was then transformed, using finer reeds and heddles, finer yarn and wires running warp-ways. The filling going over the fine wires running warp-ways left the goods covered with small loops. The goods were then placed on a table and the loops cut open the warp-way by means of a very fine knife and guide. This material having a fine pile on the face was known as velvet. As production was very slow, an English engineer invented a loom to weave two pieces of goods at one time, using one shuttle. The shuttle would rise and fall for each piece individually, using two warps, one for the binder and one for the pile. The goods were taken from the loom and put in a splitting machine, which cut the yarn in the middle, leaving two pieces of cloth. This type of weaving went on for many years till the double shuttle loom came in and eliminated the rise and fall of single shuttle. This double shuttle sped up production quite a bit, but the goods still had to be cut by splitting machine, as stated above.

To-day Crompton & Knowles have a loom which eliminates this hand cutting by cutting on the loom itself as fast as the goods are woven. These goods as now woven are known to the trade as plush.

The gray goods are taken from the loom in 50-yard double cuts and carried to the inspection table where all imperfections are sewed in by the menders. The gray is now carried to the dusting machine and from there to the gray shears where the pile is sheared down even. The goods are now ready for the dyehouse.

The Dyeing of Pile Fabrics

Six, eight, or whatever number of pieces may constitute a load to be dyed are now picked from gray stock, getting the same length in each piece if possible. These pieces are accurately weighed and load numbered accord-

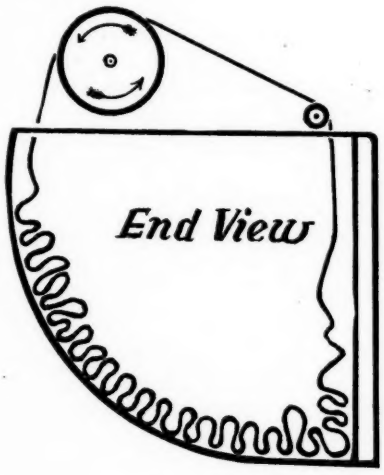
*Paper presented at the Summer Meeting of the Piedmont Section, held in Asheville, N. C., July 21, 1928.

ing to that particular dye kettle in which it is to be dyed. This weight and kettle number are recorded and sent to the laboratory for use in figuring dyestuff for the load in that particular kettle. Each batch must be weighed, drugs figured, dyeing carried and shade matched independent of any and all other dyeings.

The type of machine in which the dyeing is to be carried out must be figured in on the formula. Each machine has its own characteristics and these must be found out and accurately recorded from past experience with same.

Some of the major factors that are of such vital importance to know are these: the time taken to load machine, to fill the machine with required amount of water, heat this water to required temperature, cool this load down, empty this kettle of water and the unloading of the machine. The speed of machine must be constant, and at such as give best results. The creels must be correctly placed above the kettle. These factors are essential in order that you may display the utmost accuracy in matching and secure the best results in the finished product.

The gray goods constituting the load are placed in the machine, going around the creel and support roll, folding gracefully in the kettle box as shown in the diagram. Each piece has its own path to travel and is kept in that path by guide pins at top of kettle. When the kettle is loaded and in operation each piece has a tendency to support the other, thereby helping each to travel in its own path throughout the complete circuit. The kettle



is now filled with water to a point where the goods are properly immersed to a sufficient volume to attain a thorough boil off. On wetting the goods out, the proper boil-out compounds are now added after being thoroughly dissolved and strained. The steam is turned on and the liquor is brought up to the boil-out temperature that is required for that particular grade of goods being processed. This temperature is held until the goods have received a thorough scouring. Right here is one of the most important steps in processing a beautiful piece of piece-dyed plush. The handling of the goods, temperature, water and boil-out material at this stage of the work cannot be given too much consideration. The oils and alkalies used in boiling out the goods must be soluble and free from any sticky substance that might affect the pile.

After the boil-out comes thorough rinses. The boil-out merely loosens many of the impurities from the goods, and if they are not rinsed off and washed into the sewer the full benefit of the boil-out is not obtained. Any insoluble matter sticking to the pile will not only cause spots and unevenness in dyeing, but if not rinsed off the goods it will go through to the finished product, causing cloudy material. Any substance used in boiling out or dyeing pile fabrics which is of a sticky nature is in danger of causing the goods to finish up unsightly, especially where this substance cannot be thoroughly rinsed off.

We are now ready for the dye liquor, for the goods are in a clean, firm but soft condition. The water volume for dyestuff is now accurately measured, being figured in proportion to the weight of goods to be dyed. The dyestuff, which has been previously dissolved by boiling, is now added slowly to the water in the dye kettle. The temperature is raised to desired point where the dyeing is to be carried out. This temperature is brought up in a specified time and held there a few minutes before salting begins. This time and temperature is regulated by the size of load, the grade of goods and surrounding conditions. Salt is now added to the bath in small proportions, while the temperature of the bath is held constant throughout. Both common and Glauber salt are used, the amount depending on the depth of shade and the type of dyestuff. The percentage of salt used is relatively high due to the long bath and slow exhausting dyestuff which is found to be best for this purpose. Handling of the salt at this stage *is very important* and largely determines the accuracy of matching and uniformity of dyeing.

A sample is now cut from one of the pieces in from 10 to 40 minutes after the final salting. This time depends largely upon the size of load, the depth of shade and the type of dyestuff used. The machine is stopped long enough to secure a sample. It is important not to have the machine stop longer than necessary while getting a sample or any time while the dyeing is in progress, for standing will not only cause streaks or spots on goods, but will distort the pile to such an extent that it cannot be properly finished, thereby giving a cloudy piece of finished material. It can be easily stated that as much care must be exercised in dyeing pile fabrics to keep down cloudiness as must be exercised in getting evenness.

This sample is dried and cooled as quickly as possible.

It is then compared to standard sample and should be slightly lighter, generally speaking. The next sample is cut from the machine in from 10 to 40 minutes after first sample and should be, after drying and cooling, just about a match to standard. This sampling is carried on until the shade comes up to just what is desired and the liquor is dumped. Allowance must be made in sampling between the time the sample is cut from machine and time it is found to be a match to standard. This time varies from around four to twenty minutes, depending on just how long it takes to cut, rinse, dry and cool the machine sample. There are shades of green that will take an unusually long time to cool and develop to a shade where an accurate match can be obtained.

While the machine sample is being dried, cooled and compared to standard sample, the dyeing is going right on and the shade is getting heavier. The shade not only is getting heavier during this period, but is being changed in tone due to one or more of the colors used in combination having a little slower exhaustion than the rest. It requires extreme care and continued practice in making the proper allowance in sampling from the machine so as to get an accurate match on the take-out. In drying the machine sample, it is found best to do so with warm circulating air. As this air drying is rather slow, the hot steam cylinder is usually resorted to. Cylinder drying is done quickly and it is this time saved that is so important. The disadvantage of cylinder drying is that some shades are weakened on coming in contact with the hot surface. This dulling of shade must be allowed for in matching.

Study Dyestuff Properties

It is necessary to know the working characteristics of the dyestuffs you are using in order to secure a good match and even results. Dyestuffs that dye evenly and exhaust uniformly and slowly under various temperatures and at different concentrations are necessary. Colors are best used in combination which exhaust at same speed or nearly so.

When shade is secured, the dye liquor is dumped and the final rinses are made. The goods are rinsed clear of loose color and the cloth is left in a cool state. While the dye liquor is being dumped and the rinses are in progress there is a simmering or slow exhaustion of the several colors left in the liquor due to the cooling bath. Being familiar with the several colors that constitute the formulas you may allow for the taking on of those colors that exhaust in the cooling bath. To get a final check on this last exhaustion a sample is cut from the final rinse.

Finishing

The goods are now removed from the machine and run through a vacuum extractor at full width. The dyed goods are carried to the finishing room where they are wet finished, dried and dry finished. The main object of the finishing process is to bring the pile up straight and uniform, later laying the pile at required angle for that particular grade of goods. By the aid of the tiger machine, steam brush, shearer, and plusher, the finisher does his work. In the hands of a skilled finisher the rough pieces of pile fabrics coming from the dyehouse are converted into a beautiful, lustrous and soft material for which there are found so many uses.

The Forest and Industry*

By Robert W. Griffith

BECAUSE of the great contributions of chemistry to the progress of our modern civilization, the age in which we live may properly be described as the Chemical Age. Since Perkins separated the color mauve from coal tar, the chemistry of coal tar has probably been more thoroughly explored than any other raw material, and now chemists are turning their attention to the study of cellulose and its compounds, and it is quite probable that this field will yield wonders that may surpass the triumphs resulting from the investigation of coal tar. Already progress has been made in cellulose chemistry, which has had a tremendous effect upon the textile industry in the development of rayon.

The paint industry also has felt the result of the development of such materials as Duco which is a cellulose product, and the use of varnish finishes on furniture is being threatened by cellulose lacquers. Leather finishes, too, are being made with a cellulose base, which has great advantage over the old albumen and milk finishes.

Nature is generous in her production of cellulose, as this material predominates in all vegetation, and in the cotton plant it is produced in its purest, natural form.

The most abundant source of cellulose is wood, but the cellulose content of wood varies according to its species, and while many forms of vegetation are capable of yielding cellulose in commercial quantity, yet wood continues to be the cheapest source of cellulose.

The paper industry is by far the largest consumer of wood cellulose, although the rayon industry will no doubt steadily increase its large consumption as it develops.

Cellulose in Paper Making

The introduction of wood cellulose for paper making is undoubtedly one of the great contributions to modern civilization. Before wood cellulose was used, paper was made from linen and cotton rags, and the result was an

*Paper presented at the Summer Meeting of the Piedmont Section, held in Asheville, N. C., July 21, 1928.

expensive product which would hardly permit of its free use, such as we witness to-day in the conduct of business and as the medium for popular education. The importance of a cheap and plentiful supply of paper is now generally recognized, although it is doubtful whether the importance of conserving the source of the raw material for wood cellulose is as well recognized.

It is only by the exercise of the principles of sound foresty practice that we may hope to perpetuate the supply of wood for cellulose, and while the need for forest protection is accepted by responsible authorities, the necessity for a wider recognition by the general public still remains.

A variety of woods enter into the production of paper. Some woods, like gum and poplar, make short fibered pulp, and spruce and hemlock make long fibered pulp, which gives strength to paper. There is a difference also in the amount of the yield of pulp from different woods. All short fibered pulp is produced by the alkali or soda process, and the long fibered pulp is produced by the acid or sulphite process. In the case of wood like chestnut, which is rich in tannin, it is necessary to first extract the tannin from the wood before it can be converted into pulp by the soda process.

The production of modern paper is essentially a chemical industry, embodying as it does a number of many chemical processes which in many instances constitute separate industries. The soda process, for example, requires caustic soda for cooking the wood, and in the process this is converted into sodium carbonate, which is recovered, concentrated and reduced to ash. The ash is causticized with calcium hydroxide and reconverted into caustic soda and used over again. The calcium oxide in turn is converted into calcium carbonate and this is recovered and reburnt into calcium oxide, thus making a continuous and double cycle of operations.

In the sulphite process, sulphur is burnt to form sulphur dioxide, which is passed into calcium hydroxide to form calcium bi-sulphite, which becomes the cooking liquor, and there is only a partial recovery of this residual liquor.

Bleaching Wood Pulp

It is necessary to bleach all wood pulp used for white paper, and this is done by means of calcium hypochlorite. Many paper mills produce chlorine for their own use by the electrolysis of sodium chloride, and so obtain caustic soda as a by-product.

The standard methods of cooking wood into pulp are of long standing, and have been developed largely from experience, but as the chemistry of cellulose becomes better understood we may look with confidence to great developments, not only in paper manufacture, but also in a wider application of cellulose products.

The forest resources of the South constitute a great national asset, too frequently overlooked.

In the Southern Appalachians the stand of chestnut timber constitutes the only national resource for the production of vegetable tanned leather, and when this is exhausted the country will be entirely dependent upon foreign sources of supply for tanning materials.

Turpentine and rosin are forest products of the South that are a valuable source of national wealth and contribute to the industrial development of the South, so that the need for a forestry program looking to the continuity of the supply of naval stores is worthy of very serious consideration.

Apart from its industrial application, the forest has a still wider significance as a resort for recreational purposes, and it is gratifying to note the emphasis which has been constantly placed on this feature by the U. S. Forest Service in their excellent administration of our foreign resources under their control.

The U. S. Forest Service has interpreted conservation in its best sense in that it puts the forest to wise use. In the forests of the South we have a great inheritance which it is our duty not only to use wisely but to so govern our forest activities that they will be perpetuated and be as available for the next generation as they are to ours. The forest allied to the jungle exists no longer. In its stead we have a form of public utility which is being developed into a great reservoir of raw material that contributes not only to our industrial development, but is an immense contribution to our national progress.

ANNUAL OUTING OF THE NORTHERN NEW ENGLAND SECTION

THE annual outing of the Northern New England Section was held on June 16, 1928, at the Kenosa Country Club, Haverhill, Mass. Outing Chairman Gile and his committee had arranged an excellent program. This, coupled with the ideal weather conditions and the strikingly beautiful surroundings of the clubhouse, assured every one of the seventy-five members and guests a glorious time, whether he played or frolicked or lounged.

Golf was the leading sport and it kept numerous groups in action. Tennis had its supporters also. Several hard matches were played off in both doubles and singles. Baseball was a relaxing diversion, and this, along with a certain financial situation, gave the piazza specialists considerable fun, and the contestants much activity.

The outing was concluded in the evening with a most excellent banquet, and an enlivening entertainment in which several of the spectators also took part. Later,

prizes were awarded to the successful sports candidates in golf and tennis. No one won the quarter.

A brief business session was called in which the election results for officers for the coming year were announced. The officers elected were: Chairman, William H. Cady; treasurer, Walter C. Durfee; secretary, Dr. H. C. Chapin. Members of Executive Committee for two years: Thomas J. Biery and Frank L. McCool. Members to represent Section on the National Nominating Committee: Harry R. Davies.

As soon as the results of the election were announced, Chairman Leitch turned the reins of control over to Chairman-elect Cady.

Mr. Cady made a brief speech of acceptance and closed the outing formalities with a stirring challenge to each and every member of the Section to do his bit in co-operating to make the coming year's activities highly profitable and successful to the Section and to the Association in general.

A. K. JOHNSON, *Secretary.*

MEETINGS OF THE LOWELL JUNIOR SECTION

A VERY interesting meeting of the Lowell Textile Junior Section was held at the Institute on Friday, March 23. Twelve members and three guests were present.

Chairman Killheffer introduced the speaker, Albert Joerger, of the Washington Manufacturing Company, who delivered a paper entitled "Testing of Dyed Materials for Fastness to Light."

Mr. Joerger spoke on the variables and factors affecting dye fastness to light and the effect of dye material, environment, and light to dye fastness. He also considered the application of mordants, aftertreatments, mixtures to fabrics and their variances in fastness according to these factors. He likewise considered the effect of temperature, humidity and the different types of light to fabrics in regard to light fastness. Mr. Joerger, in conclusion, described a method employed by his company in testing fabrics and described the various processes used in the tests. After the meeting, Mr. Joerger showed the members and guests several samples which he had brought with him and the tables and charts with data collected from these experiments.

The meeting adjourned about 4.55 with a rising vote of thanks to the speaker.

The second meeting of the season of the Lowell Junior Section was held at the Institute in the chemistry lecture room on April 6, 1928, Friday afternoon at 2 o'clock. Over fifty students and instructors gathered to hear the speaker of the day, Dr. E. H. Killheffer, president of the Association.

The title of Dr. Killheffer's address was "The Cowardice of Mediocrity." He gave several stories of actual experiences which he had met with, and brought out many valuable facts as to how to be a success in the textile industry. Mediocrity, he pointed out, is a breeder of timidity and lack of mental courage, and he urged sincerely that the members of the audience take full advantage of their opportunities if they are to achieve the success they desire. Dr. Killheffer discussed the "first job" and the folly of putting remuneration above the gaining of valuable information. He also spoke of the proposed technical bureau and laboratory of the A. A. T. C. and the work proposed by it.

Mr. Killheffer's speech was a great aid to the students and many will remember what he said. After the meeting the members gave him a rising vote of thanks for his splendid talk and the meeting was adjourned at 2.45.

EARLE R. MCLEAN, *Secretary.*

COMMUNICATION

Alcohol as an Assistant in Dissolving Sulfanthrene Pink FF

From the Technical Laboratory, Dyestuffs Department, E. I. du Pont de Nemours & C., Inc.

Some time ago we were faced by the problem of finding a method for producing an extremely concentrated vat of Sulfanthrene Pink FF. The concentration called for was one part of dye paste in ten parts water. Under these conditions the dye reduces completely, but the leuco compound is not soluble enough to stay in solution except very occasionally and dyeings made after diluting this strong solution vary very much in strength. The method which proved effective in getting around this difficulty may be of interest to others, and therefore we publish this note.

It was found that if the vat was made up by using one part of Sulfanthrene Pink FF Paste, three-quarters part sodium hydroxide, one-half part Du Pont hydrosulfite concentrated, reduced in ten parts of water at 120° F., and then three to four parts of ethyl alcohol added, the formation of a precipitate was avoided. When diluting this stock solution it was found advisable to add one-quarter of an ounce of Nekal to each gallon of dye bath. This prevented the formation of any hard scum on the top of the dye liquor.

The use of alcohol increased the strength of the dyeings obtained more than sufficiently to pay for the cost of the solvent.

Changes of Address

Beck, Joseph F., 23 Fenier Place, Irvington, N. J.

Boyle, Henry G., Connecticut Lace Works, Norwalk, Conn.

THE PREVENTION OF MILDEW IN COTTON GOODS

(*Continued from page 532*)

iodine served as a good indicator as to how far into the yarn the size had penetrated. As the accompanying photomicrographs (Plate IV) show, the penetration was very good.

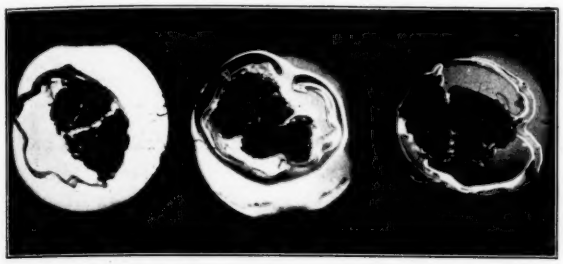


FIG. 4—(*See Text*)

10. The cost of using Neomerpin O as an antiseptic in size would be somewhat greater than that of zinc chloride. The market price of Neomerpin O is 40 cents per pound in drums, as against 6¼ cents for zinc chloride. The following example shows the comparative cost of the two antiseptics in the finished cloth:

Example: Let it be assumed that the warp contains 10% of size (an average figure), and that the warp constitutes 50% of the finished fabric. Then the cloth would contain 5% of size; and if it be assumed that the cost of sizing 1 pound of warp is 1 cent, then the sizing cost per pound of cloth would be ½ cent. On this basis the cost of sizing 100 pounds of cloth would be 50 cents. If 2% of Neomerpin O is added to this size, 0.1 pound would be required (per 100 pounds of cloth) and the cost would be 4 cents (at 40 cents per pound). This represents an additional cost over that for the plain sized cloth of 8%. On the other hand, if zinc chloride were used, 1%, or 0.05 pound, would be required, at a cost of 0.3125 cent. This represents an additional cost of only 0.625%.

In other words, the cost of using Neomerpin as an antiseptic would be almost thirteen times as great as that of using zinc chloride. Whether or not this disadvantage would be offset by the greater efficiency of the Neomerpin O remains to be seen.

SUMMARY

A general study of mildews and their action on cotton goods has been made. It has been found that, while molds will, under favorable conditions, attack the cotton fiber itself, the addition to the yarn or fabric during the sizing and finishing operations of materials favorable to fungal growth renders the cotton much more liable to attack. The only practical method by which this can be controlled is the addition to the size or finish of some antiseptic substance which will render the material unfit for fungal growth.

An investigation of the toxicity of various antiseptic substances was made, with particular emphasis on certain ones—namely, certain brominated beta-naphthols and their derivatives, Neomerpin, Neomerpin O and Hexalin. It was found that although the brominated beta-naphthols and their naphtholates are highly toxic toward molds, there are serious objections which would prevent their use in textile work. The sulphonic acids of the brominated beta-naphthols were found to have no antiseptic value under the conditions prevailing and in the concentrations used in the tests. Hexalin also was found to be non-toxic toward mildews. Neomerpin and Neomerpin O were found to inhibit the growth of the fungi, but in a peculiar manner. Apparently the mold must make a start before these substances come into action; then they exert a toxic effect which arrests the growth, or else so very materially retard it as to remove the danger.

Further tests were undertaken to determine the suitability of these substances (Neomerpin and Neomerpin O) under the ten requirements of an ideal textile antiseptic as set forth by L. E. Morris, of the British Cotton Industry Research Association. According to the results of these tests, both of these substances seem to be suitable except for their cost, which is about thirteen times as great as that of zinc chloride. It is possible, however, that the greater efficiency of Neomerpin and Neomerpin O may be enough to offset this difference in cost.

In the "discovery" of the Neomerpins the object of the thesis was, up to a certain point, attained.

It is to be regretted that it was impracticable in the present investigation to take account of the specific differences in toxicity of the various antiseptics. As other workers on this problem have pointed out, a substance may be four or five times as toxic toward one species of mildew as it is toward another. If further work were to be done by the author, an effort would be made to take this fact into consideration by using several different known species of mold in the tests. Further work along this line would also involve practical tests on the slasher and in finishing operations. One more possibility with regard to the brominated beta-naphthols arises: That one of these compounds—preferably the 1,6-dibrom-2-naphthol on account of its higher melting point and lower volatility—might be emulsified by means of some suitable agent, and in this form incorporated into a size mixture. The high antiseptic value of these compounds renders the possibility attractive.

J. WILLIAM CLARK

J. William Clark, president of the Clark Thread Company, Newark, N. J., died suddenly of heart trouble at his estate at Bernardsville recently. Mr. Clark, who directed the thread concern's affairs up to the day before his death, had long been active in the business life of Newark, and also found considerable time to devote to philanthropic undertakings. He had been in failing health for several months. He was born in Newark on July 29, 1867, the son of William Clark, one of the founders of the Clark Company.

Method of Dyeing Fine Denier Artificial Silk Woven Fabrics

By B. L. Hathorne
Tubize Artificial Silk Company of America

THE fine denier artificial silk fabrics are handled at present on jigs, pads and on the open kettle. As all dyers who have handled these fabrics know, it is a case of trying to choose the least of three evils. One may have trouble from streaky goods, creased goods or frayed goods, according to the machine one prefers to use.

The jig, especially ball-bearing jigs, has been widely used for this type of work. Unquestionably from a mechanical viewpoint the jig is to be preferred, as one avoids creases and fraying and is subject only to occasional broken cut. Unfortunately, however, even on the best ball-bearing jigs, the warp is subject to tension, which is one of the major causes of warp streaks. Then again, the actual effective dyeing temperature of the jig is always below 200° F.

The padder is perhaps the least of the three evils, as it dyes so rapidly that the warp streaks are largely avoided. It is to be regretted that the pads now in use were mostly designed for heavier fabrics and have the undesirable property of fraying some voile constructions. Another undesirable feature is the effective dyeing temperature, which rarely can be made to exceed 180° F. Then again, it is obvious that crepe constructions cannot be handled on a pad.

The open kettle, though sometimes used, is a bad actor. Tangles, unavoidable on an open kettle, invariably mean torn goods when extra sheer artificial silks are handled. Perhaps even more serious are the creases from the reel, due largely to the high twisted yarns necessary in the fabrics being considered. Then, too, the temperature in the back of the kettle will not even reach 185° F.

The above-mentioned troubles—bad enough in the ordinary 75 denier qualities—are becoming still more serious, due to the growth and popularity of the recent 50 and 35 denier sheer fabric manufactured from tubize artificial silk. These fabrics are rapidly coming to the fore and are so fine and light as to deserve special handling by the dyer and finisher.

It is the opinion and experience of the writer that the ideal machine to piece dye all artificial silk voiles and crepes is the recent drum type of hosiery dyeing machine. These sheer fabrics are so light that a surprising amount of fabric can be put into each pocket. The goods can then be scoured and dyed without danger of tears, fraying or kettle creases. The fabric can be scoured and dyed in the same machine without loss of time, which is always an advantage. There is absolutely no tension on the warp, which means much less tendency toward warp streaks. Best of all, however, is the dyeing temperature, which can be easily held between 200° and 205° F.

When the drum type of hosiery machine is used, when dyestuffs are carefully and correctly chosen, and when the dye is run at as high a temperature as is possible and in the absence of, or with the minimum amount of Glaubers salt, said salt to be added at the boil, artificial silk voiles and crepes are produced practically free from mechanical breaks and dye bars.

SULPHURIC ACID

Most laundry owners have undoubtedly had experience with the damage caused by the spattering of radio battery acid where batteries of the sulphuric acid type are used. Should there be any who are not familiar with this rather common cause of damage to goods which reach the laundry, they should obtain a good bulletin discussing the matter.

There are other cases of damaged goods which give every evidence of being traceable to sulphuric acid but which have no radio battery history. It is possible that in some of these cases the trouble is caused by carelessness in handling the sulphuric acid which is used for cleaning up the cylinders of the washing machines.

When cleaning wheels with sulphuric acid, be sure that all trucks and goods are kept at a safe distance from the wheel which is running in a hot sulphuric acid bath. Even the smallest drops or spatterings will prove very destructive to anything which they touch. A drop of sulphuric acid on cloth shows no quarter—it destroys every time.—*Cowles Comments.*

CAMEL GREENS LISTED IN NEW FOLDER

Claiming the position of America's leading manufacturer of greens, John Campbell & Company has just issued an attractive broadside or mailing folder describing briefly all of its various shades of green in the different series of Camel Dyes manufactured by the company. Five distinct shades of green in the series of Amidine colors are described, their outstanding properties featured and the shade designated. There are also several Aceko and Ethonic Greens included in the listing, as well as various special greens for wool, Celanese and other materials.

The text of this interesting folder emphasizes the universal popularity and application of the color green and stresses the importance of fastness and completeness of range, features claimed for Camel Greens in each of the various series.

The American Printing Company, Fall River, Mass., will be entirely operated by electrical power in the near future. The No. 1 and No. 2 plants of the cotton division have been run by motor power for some time, and during the recent shutdown motors were installed in the No. 3 mill.

AMERICAN
DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

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THE MIDAS OF FOREIGN CHEMICAL INTERESTS

MANY ideas that are born of American brains go to Europe when young and there grow to gigantic size. In fact these ideas do not merely "grow," but are skilfully developed by European ingenuity into great enterprises. Furthermore, in many cases, the ideas become great through the timely aid of American gold. For Wall Street is the King Midas that gilds the schemes and plans of our foreign competitors.

We may watch this process now going on in European industry. We can see it clearly in the projects carried out recently by European chemical trusts. The idea of borrowing and pooling huge resources of capital to improve and perfect manufacturing processes was first tried in the United States with steel, oil and other basic commodities. This idea, following others across the Atlantic, has been applied to chemical manufacturing, and has reared a formidable machine against us.

The European dye and chemical barons have been busy all this summer—planning and building stronger cartels. They have done more than sign a few agreements covering markets. They have not merely exchanged a few patent rights over a glass of lager. In reinforcing their trusts by pact and capitalization they have created an amazing industrial situation. But even more amazing is the calm, complacent manner in which the American industry takes in that situation. Because these giants that were once American ideas happen to be sleeping quietly, they do not excite our fears.

But several of the new European industrial Titans have never been asleep. The Imperial Chemical Industries, Ltd., for example. What do we know about it? Great Britain's most powerful consolidation, born full-armored almost overnight only two years ago, comprising the British Dyestuffs Corporation and three other large chemical interests; a well-managed, heavily financed group, highly successful in everything it has so far undertaken. It has been the major factor in giving England a strong dyestuff industry, a stronger heavy chemical industry. It controls the markets for hundreds of important products.

Once upon a time we thought that the British dye industry was headed for certain destruction on the treacherous rocks of an agreement with the German trust—proposed but never signed. The creation of the Imperial Chemical Industries removed the need for that. Now the dye industry is not on the rocks, but is standing on a rock—the rock of ample capital and sound management. Britain's output of coal-tar dyes swells from year to year. Thirty million odd pounds in 1926; 39,500,000 pounds in 1927; vat dye production jumping 41% in one year; the output of sulphur colors boosted 53% in that same year; all other classes of dyes produced in larger quantities.

What can England do with the surplus that must come from such expansion? The answer lies in more efficient production, in more extensive marketing operations abroad, in agreements with foreign competitors. Losses in one field must be recouped in other fields; new and valuable products developed and supplied to consumers in the world's markets. Profitable relations must be maintained with either European or American financial and industrial interests. But in his annual report, presented in June, we find Sir Alfred Mond, chairman of the I. C. I.'s directing board, declaring that "This company will never make any understanding or agreement which will in any way hamper the legitimate development of its activities. . . ."; and furthermore, "We lay it down as a cardinal fact that we are the guardians of national safety in the way of production of chemical products, that we are the guardians of the development of the chemical industry of this country and of Europe."

Sir Alfred never minces words He talks in facts, "cardinal" facts, and his canny British sense of values is as clean-cut as a block of onyx. The I. C. I. is not to be intrigued into any treacherous alliance with the more powerful interests across the Channel; that might have happened three years ago but not now.

When the great British chemical trust does make a move, therefore, we may expect it to be an extremely shrewd one. The move made by the I. C. I. in April was that, and more. After some veiled negotiations with the Chase Securities Corporation of New York City—strong American financial interests—the veil was removed and the industrial world beheld a new colossus astride the Atlantic, the power of two billion dollars centralized in the Finance Company of Great Britain and America, with Sir Alfred comfortably settled in the chair of the directing board. An enormous reservoir of American capital was drawn upon

to feed the development schemes of a strong British chemical trust.

The functions of the new Finance Company, its chairman explained, will be directed to the development of new processes and the increase of production. The concern is described as "part of the machinery for stimulating and developing productive industries" in England and other parts of the Empire. In reporting this American-financed venture our London contemporary, The Dyer, states that:

> "There has been for some time a relationship between the great industries of Britain and the United States, and the formation of the new company will bring the leaders of industry in both countries into very much closer and more intimate co-operation."

Are we being too curious if we inquire how the use of American gold by an English trust to finance that trust's expansion can be interpreted as a form of "intimate co-operation" between our industries and those of Great Britain?

In this age of national cartels and mergers nothing has perplexed economists more than the way so many American banking firms work against the best interests of home industries. What motive acts so strongly to persuade the financial power of Wall Street to strike backhanded blows at one of this nation's most vital industries by their liberal loans to foreign competitors? Are American millions in so little demand in America? We concur fully in all that has been spoken on various occasions by well-meaning peace delegates; we respect the sacredness of amicable relations between the United States and the British Empire. But we will probably be branded as demagogues because of our protest against the short-sighted policy of our international financiers in supporting the research plans of foreign interests so formidable as the I. C. I.

TOO WARM TO WORK?

THE humid weather of a summer like the present one exerts a most disagreeable effect upon temperament. We tend to be more easily irritated by trifles. The heat of the sun blazing through the window seems to call forth a nervous, irritable response from the heat of our disposition. The humidity apparently adds an extra strain to sensitive nervous systems. All of which is merely another way of saying that at this season many of us are thrown off balance more quickly by trifling mishaps and obstacles that would not be noticed in cooler weather.

If a shade card is mislaid or a formula fails to turn up on its proper page in the scrapbook, one is more ready on a humid day to swear volubly, disturbing the ordinarily meditative silence of the "lab." At this season more than ever, therefore, those who are responsible for the detail work of filing color cards, samples, formulas and all the other innumerable paraphenalia used in the modern dyehouse laboratory can appreciate the value of a good system. Conversely, those who lack a system will surely reap the full penalty in lost shade cards and misplaced formulas, to say nothing of lost tempers and misplaced epithets.

This season, furthermore, is obviously the best time of the whole year to undertake a systematic clean-up and file-away "campaign" in the dyehouse. When it's too warm to work hard and too humid to loaf comfortably, why not try to organize a neat, systematized file for those shade cards, pamphlets, booklets, notes, samples and other odds and ends that litter shelves and corners of the "lab"?

BRONX COMPANY JOINS EASTON DYE WORKS WITH PLANT IN THE SOUTH

S. L. Hayes Appointed General Superintendent—New Plant Buildings Planned

Among the most important recent events in the textile industry is the combination of the Bronx Company of New York City with the Easton Finishing Company, of Easton, Pa., the arrangements to include the transfer of their equipment to Hartsville, S. C. The new company will be known as the Hartsville Print and Dye Works and will be equipped to handle all processes in the finishing of cotton and rayons and mixtures.

Samuel L. Hayes, who has been superintendent of the Bronx Company plant in New York several years, will be general Superintendent of the new mills at Hartsville. Mr. Hayes, a Southerner by birth, is well known to most readers of the REPORTER as the chairman of the New York Section of the American Association of Textile Chemists and Colorists for the season 1927-1928. The REPORTER is glad to take this opportunity to felicitate Mr. Hayes upon his taking over the larger responsibilities of his new capacity and to express the hope that even greater things lie in store for him.

The Easton Finishing plant had completed plans some months ago to move to Hartsville, where buildings have been under construction to handle the bleaching, dyeing and finishing operations of the firm. In view of the new combination, however, an additional structure of about 80,000 square feet will be erected at Hartsville to house the print works, which will adjoin the other units of the plant.

The rayon department of the Bronx Company, which is to be moved southward, includes silk frames and calenders. Among the equipment scheduled to be moved will be five printing machines with from one to eight color combinations. With its combined equipment and other modern plant facilities the new company will rank as one of the most complete finish-

ing plants in the industry. The daily production will be approximately 250,000 yards, with a boiler capacity of 2,000 horse-power, and about 250 employees. It is obvious that the united operation of the two concerns will result in reduced overhead and larger production, with room for expansion when required.

The officers of the Hartsville Print and Dye Works are Frederick B. Voegeli, president and general manager; A. L. M. Wiggin, vice-president and financial director; Robert Bole, treasurer in charge of sales, and R. A. Terry, secretary. Mr. Wiggin is vice-president of the Trust Company of South Carolina, located in Hartsville. Mr. Bole will be assisted by his son Robert S. and by William Charnley on the sales end.

Roberts & Company, engineers of Atlanta, will have charge of erecting the new building in Hartsville. The dismantling of the Bronx Company plant has already been started. The moving of equipment to the South has been made possible through the efforts of the Carolina Power and Light Company, of Raleigh, N. C., and of the Seaboard Airline Railway Company.

The Society of Chemical Industry and the Geigy Plants at Basle

The Laboratories and Their Researches on Rayon—Manufacture of Vat Colors—Recent Products—Prints and Printing—The Geigy Plant—The Printing Laboratory—Dyes for Acetate Silk

By Charles E. Mullin, M.Sc., F.C.S., F.A.I.C., F.T.I.
Professor of Textile Chemistry and Dyeing at Clemson College, S. C.

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THE Ciba Company, of New York, known abroad as the Society of Chemical Industry of Basle, has an immense plant located on the Rhine at Basle, Switzerland. Through the courtesy and kindness of President Alfred F. Lichtenstein and William E. Mitchell, sales manager of the Ciba Company, and the commercial and technical management at Basle, I had the great pleasure of visiting all parts of this plant, including the research, control, dyeing and printing laboratories.

These laboratories are under the personal direction of Dr. O. Jack, one of the technical managers, who is very much interested in one of my own hobbies—acetate silk. The Ciba Company markets quite an extensive line of dyes for acetate silk under the Cibacet brand, and Dr. Jack was able to show me some very interesting patterns on all sorts of combinations of the various brands of acetate silk (Celanese, Rhodiaseta and Setilose of the Tubize Company), with other rayons, cotton, wool and true silk.

Some interesting points came up in the discussion of these samples, such as the fact that cotton-back plushes with an acetate silk pile are considered more resistant to wear and mechanical treatment than similar plushes with a viscose pile. Certain of the Cibacet colors are well adapted for dyeing acetate silk in the presence of true silk, to leave the latter unstained; for example, Cibacet Sapphire Blue G. Potting Chrome Black B gives a very good black on true silk without staining acetate silk, etc.

Making the Vat Dyes

Their vat dye manufacturing plants were also of particular interest to me, as most of them are quite new and modern, having recently been rebuilt to take care of the constantly increasing demand for the vat colors. In spite of the fact that nitrobenzene or other organic solvents are used in most operations in vat dye manufacture, no odor of these solvents was detectable in the air of the plants.

Each particular Ciba or Cibanone dyestuff, some of which were discovered by Dr. G. Engi, vice-president of the company, is manufactured in special equipment, although the closely related dyestuffs are usually grouped together in the same building under skilled direction. In spite of the fact that the hand labor in these vat dye plants has been reduced to a minimum, each plant is so clean that there is no danger of soiling either the hands or clothes in visiting them.

Certain new products of the company were of particular interest to me; for example, the Chlorantine Fast Reds 5GL and 6BL. These approach the fastness of certain vat colors to light and are very suitable for use upon cotton, rayon and silk materials, such as tricot and hosiery. Brilliant Direct Pink B and 3B approach Rhodamine in shade, but are of better fastness and are, therefore, of great interest for certain work. Rosanthrene Brilliant Red BR, when diazotized and developed, is one of the most brilliant reds, said to be of good fastness to washing and light. Chlorantine Fast Yellow 5GL is of interest on account of the purity of shade and fastness to light. Cibanone Blacks DA and EA (for machine dyeing) and BF and EF are of interest due to the fact that they give the black color directly without the usual chlorine aftertreatment.

Researches on Printing

A particularly interesting phase of this visit was that of meeting Prof. Dr. R. Haller, head of the printing department. Undoubtedly all of you are familiar with Dr. Haller's work, and many papers upon the state of dispersion of the dyestuff in the fiber, the relation of this factor to the change of shade in various processes and the fastness to soaping, rubbing, hot ironing, etc. Dr. Haller proved to be as congenial and interesting as his work indicates. He is doing considerable experimenting upon the printing of acetate silk and the printing of Neolan and vat dyes on wool.

In Europe everyone seem to be interested in some sort

of a wetting-out agent, and the Ciba product along this line is Sapamine. Sapamine CH is offered as a wetting-out agent for use in the carbonization of wool, either in the form of raw wool or piece goods, by the sulphuric acid or aluminum chloride process. Chemically this product differs quite considerably in composition from many of those now offered on the market, in that it is diethylaminoethyloleylamide hydrochloride.

$$CH_3(CH_2)_7CH = CH(CH_2)_7CO—NH—$$
$$CH_2—CH_2—N(C_2H_5)_2.HCl$$

This compound has the specific property of solubility in acid solution and at the same time lowering the surface tension—*i. e.*, increasing the wetting-out properties of the solution to a very great extent. Undoubtedly it will be of particular interest in connection with the carbonization of piece goods where it is essential to get the most level results with the lowest possible acid concentration and carbonization temperature. It is not precipitated by aluminum salts and is, therefore, equally valuable in the aluminum chloride carbonization process. The amount of Sapamine used is small—say, from 4 to 24 ounces per 100 gallons of carbonizing liquor—depending upon the conditions.

The writer is particularly indebted to E. Glaser, export manager, Dr. O. Jack and M. Fisher for personal attention and courtesies at this plant.

* * *

The Geigy Plant at Basle

As I have already stated, Basle is of exceptional importance to anyone interested in the manufacture and application of dyestuffs. The plants of the Geigy Company form one of the most interesting places in Basle for the traveling chemist to see. Through the courtesy of the New York office, P. Moerikofer and Dr. Hans Hagenbach, I had a most interesting visit and saw all departments of their plants and laboratories. The Geigy Company is almost one hundred years old, and some parts of the very old plant have been preserved for historical purposes. However, the plant itself is far from old, and even at present quite large additions are under construction.

One of the particularly interesting points is the experimental plant, where all new processes are carried out first after development in the laboratory. This is a small but complete dyestuff plant, arranged in a flexible manner and equipped to handle every process in the manufacture of dyestuffs, extracts and related chemicals. The Geigy Company has numerous excellent laboratories for application, control, research, development, etc. A particular point of interest in this connection is the autoclave room, equipped with every known type of autoclave in various sizes. This, of course, is an essential part of the research laboratories.

Another very interesting point is the printing laboratory, under the direction of Dr. H. A. Muller-Guisan. They have developed many new and novel ideas in the printing line, and the hours spent in looking over and discussing their beautiful samples from all parts of the world will long be remembered. Better still, they presented me with many of these samples so that I can show my friends in America some of the interesting things that are being done in Europe along this line. Their Irga colors for printing are of interest to the mills preparing high-grade hand-printed specialties, as well as for the artistic work of the women at home.

Among their specially interesting new products may be mentioned Eriochrome Brilliant Violet B, a mordant dyestuff for the wool fast dyeing industry, giving a fine, bright, bloomy shade of good fastness to light, etc.

Eriochrome Flavine 2GL is a new Eriochrome yellow for which is claimed the same fastness qualities as the older Eriochrome yellows and flavine brands, but it is distinguished by its pure, bright, greenish yellow shade, said to be of exceedingly good fastness to acid.

Novazol Acid Blue GL and BL represent a new class of dyestuffs of the Azine series, acid level dyeing colors for wool and silk. The GL brand gives a good shade under artificial light and is claimed to have good fastness to light in dark shades.

Polar Brilliant Red B Conc. and 3B Conc. are two new members of the Polar group of azo dyestuffs. These two new products give an exceptionally pure bright blue-reddish shade of excellent fastness to light. They are said to be of good fastness to milling, washing, water, sulphur, etc. They are of particular interest for bright reds in the wool fast dyeing industry where the usual chrome dyestuffs do not give the desired pureness of shade.

Because of my study of acetate silk, the Setacyl direct dyestuffs were of particular interest. These are applied by the simplest methods to give colors which are, as a rule, quite fast to rubbing, washing, water and light. They are in powder form, which is a considerable advantage in matching shades, etc.

(*This is the second in a series of articles by Professor Mullin describing the dye plants of Europe. The third will appear in an early issue.*)

SILK DESIGN BUREAU NOW FUNCTIONING

Requirements for Registration—Prominent Firms to Co-operate

NO longer need there be the same degree of apprehension among silk manufacturers that their fabric designs will be unwittingly duplicated or pirated by unscrupulous competitors. The Silk Association of America recently organized a Design Registration Bureau, announcement of which was published in these columns. This Bureau will register all designs submitted by reputable manufacturers and its chief function will be to enable owners of designs to find out whether or not their creations are being used in the trade.

This Bureau is now ready to accept and register designs, the Silk Association announces. Until

August 20 samples of printed fabrics put into work during the past 60 days, or since June 19, will be accepted for registration, as well as original drawings of designs which it is proposed to send to printers. In the former case the samples of printed fabrics submitted must be accompanied by an additional affidavit from the printer that the printing was done from an original drawing belonging to the applicant. No decision will be made until August 20. After that date only original drawings will be accepted with the exception of fabrics printed outside the borders of the United States, which are governed by special ruling.

The effect on the eye of an ordinary observer-purchaser will be the basis of decision as to whether or not a design submitted to the bureau is a copy or a duplicate. This method of judging and filing designs has been adopted in accordance with a ruling already laid down by the Federal courts.

The first requirement for registration is that an original drawing be submitted to the bureau accompanied by information as to the number of rollers to be used, an application form to be supplied by the bureau, and the registration fee of $4.00. If the design is rejected a charge of $1.00 is made for search and the balance returned to the applicant. If the design is approved two photostatic copies will be made, one to be filed in the bureau, the other to be returned to the applicant with the orginal drawing and a certificate of registration bearing the official registry number. All designs will be printed for one year.

To be considered for registration a design must be in active use. On each application, therefore, must appear the name of the printer to whom the design is to be sent. When a design is accepted and registered, the printer mentioned is asked to notify the bureau if he does not receive the design within ten days. If the design is not forwarded to the printer with instructions within that period, the registration will be canceled.

No one will have access to the designs submitted or to the files except the bureau's staff, who have been engaged to carry on the work. The confidential character of the work will be most carefully guarded.

Letter of co-operation are being received every day by the Silk Association, it is stated, from members of the trade pledging their support of the movement to prevent design duplication. Silk manufacturer, converter and cutter who have experienced the inconvenience of having rollers engraved and afterward discovering that their designs were already in use or who have undergone the delay in patenting designs in Washington are especially enthusiastic about the establishing of a design clearing house.

Organization work has been carried on and rules of procedure formulated by the design registration committee, which includes Paul Hyde Bonner, Stehli Silks Corporation, chairman; Charles L. Auger, National Silk Dyeing Co.; Robert Blum, United Piece Dye Works; E. Irving Hanson, H. R. Mallinson & Company, Inc.; William Menke, Menke, Kaufmann & Company; Jack Y. Wilkins, Goldstein-Wilkins Corp.

ERI SILK

(*Continued from page 525*)

Eri silk may represent the product, not only of different districts, but of dissimilar breeds of moths; that is, of moths of different stages of hybridization, and these variables, together with those resulting from differences in feeding and in climatic conditions during the rearing, will all have their influence upon the conduct of the silk in the spinning and weaving mills and in the dyehouse. The outcome of this is that a method of treatment may require considerable modification in order to fit it for use on a new consignment of fiber, and therefore it is advisable to make small-batch trials before proceeding to deal with it in the way of the regular routine.

The gum having been removed, the silk is sent forward for bleaching without further need for washing. One of the most suitable formulas for this is here shown:

Water (softened)	120	gals.
Formic acid (85% tech.).....	9	pts.
Sodium phosphate	¼	lb.
Sodium peroxide	10	lbs.
Turkey Red oil	4½	pts.

This peroxide bleach bath requires a little care in the make-up if waste is to be avoided. The first step is the addition of the acid and the phosphate to the water. The peroxide is then sprinkled in a little at a time, with constant stirring. It is done in this way to avoid any local rise in temperature which would lead to a sudden emission of oxygen before the fiber is put in. The object of the phosphate is to act as a brake upon the giving-off of the oxygen and thus preserve the utility of the bath for a considerable time. When about three-quarters or so of the peroxide powder has been added the liquor is tested with red and blue litmus paper in order to ascertain its condition. If it is shown to be acid the remainder of the peroxide is sprinkled in as before and if there is still an acid reaction a small quantity of ammonia is added until the litmus papers show a gently alkaline tinge. If there is a strongly alkaline reaction it should be brought back by means of small additions of formic acid and then a few drops of ammonia to turn it over onto the blue side. The reason for exercising this care that the bleach bath is not strongly alkaline is that the luster of the silk would surely be reduced under such circumstances, for the solution is very much more concentrated than would be permissible with ordinary mulberry silk wastes.

As soon as the bleach vat is prepared and in proper

condition the fiber is entered, steam is passed through closed coils that will not allow the strength of the bath to be lowered, and the temperature is raised to 100° during the course of an hour, and maintained at that for a further two hours. The heat is then taken up to 180° and maintained for two hours more, being then shut off, whereupon the bath is covered in with its lids and the whole is permitted to remain undisturbed until the next day.

The bleach bath is usually kept for future use, and for this purpose it is necessary to convert the alkalinity to acidity by means of formic acid and it will then keep more or less indefinitely. When it is wanted again it is necessary to put in about one-third of the original quantities of the various ingredients and, of course, to work with a weakly alkaline liquor. The bath made up to the formula described above will be large enough to allow of the bleaching of a batch of cloth weighing about 55 pounds.

It is not particularly easy to remove the color from Eri silk. Another method of tackling the problem is by means of the permanganate and sulphurous acid bleaching. The process is worked in two stages; first, immerse the cocoons or the yarn in a cold solution made up with:

Water	120 gals.
Potassium permanganate	3 lbs.

The crystals should be completely dissolved before the batch is entered and the soaking should occupy about thirty minutes or more, depending upon the density of color of the silk. It is then lifted out and allowed to drain for about the same length of time, after which it is dropped into the second bath:

Water	120 gals.
Sulphurous acid, commercial quality	3½ pts.

It is necessary to make this bath up afresh for each successive batch as it will be found to have been practically used up. The fiber is moved in this bath until all the brownness has been discharged, which may require two hours or longer. After a very good rinsing in several waters, the fiber is ready to be passed out to the dyers.

Dyeing Difficult

It must not be forgotten that it is almost impossible entirely to remove the natural brown coloration from Eri silk, a property which it has in common with tussa. It may therefore come about that a satisfactory dyeing cannot be obtained with certain of the more delicate shades. Apart from this excellent results can be obtained, although, as in the case of the other so-called "wild" silks which are hard in character, it is not quite so easy to get level shades as it is with mulberry. For this reason the dye baths must needs be made up in a more concentrated form, though in other respects the usually adopted methods of dyeing are applicable. Sometimes the use of a broken boil-off liquor is not required, but as a general rule it should be used as it assists in leveling the color.

When the yarn is nearing the completion of the dyeing process it may be acidified with formic acid, which will exhaust the color from the bath. This should not be omitted, as the strength of the dye solution is greater, and it should be wasted. This is not so important, as the bath is a standing one, but this is seldom the case, owing to the comparative infrequency of the call for many batches of the same color on Eri silk.

For fabrics in which Eri is interwoven with tussa a similar method of dyeing may be successfully adopted.

Because Eri has the capacity for a more enhanced resistance to the action of alkali, the use of sulphur and of vat dyes may proceed without any of those precautions which are so vitally necessary in the case of ordinary silk or rayon. It may, to all intents, be treated as if it were cotton. In this respect it scores over its better-class sister fiber, and in consequence schappe silk fabrics made of Eri should find a ready sale in many directions where a strong real silk cloth in fast colors is demanded.

RUSSIA SEEKS AID HERE ON DYE PRODUCTION

Another European power, Russia, has recognized the need for an independent dyestuff industry, and is taking the proper steps to develop such an asset. For assistance on technical matters related to dye manufacture Russia comes to the United States. An agreement has been concluded between the Amtorg Trading Corporation, acting in behalf of the Aniltrest (Aniline Trust) of the U. S. S. R. and Professor Harry D. Gibbs, of Washington, D. C., according to an announcement made by M. G. Gurevitch, acting chairman of the board of directors of the Amtorg Trading Corporation, calling for the technical assistance of Professor Gibbs in the organization of the production in the Soviet Union of a series of chemical products used in the aniline industry. The purchase of the equipment required for these plants will be made in the United States.

The aniline dye industry of the U. S. S. R., which was practically non-existent before the war, has made rapid strides in the past few years. The development of the coke-benzol industry in the Donetz and Kuznetz basins has laid the groundwork for the building up of the aniline industry. In the past two years an annual average of over 8,000 tons of synthetic dyes was produced in the Soviet Union. Nevertheless the industry is as yet in the infant stage and a large part of the requirements is still imported. Last year imports of dyes amounted to over $9,000,000.

Technical Notes from Foreign Sources

Green Patterns on Indigo Ground

M. R. Haller; Sealed Note No. 1861, deposited September 18, 1908, with the Soc. Ind. de Mulhouse; L'Ind. Chim. et Rev. Gen. des Mat. Col. 15 (I. C. 31), 15, 1928.—Jeanmaire, in a Sealed Note (Soc. Ind. de Mulhouse) No. 1642, of date April 13, 1904, mentions a discharge permitting printing with basic dyestuffs resistant to reduction, on a bottom of azo dyestuff dyeings. Haller has tried the same process upon cloth dyed with Indigo, and claims good results. The discharge dyestuff paste, that of Jeanmaire, is prepared as follows:

(A) 540 g. Gum Solution 1/1
150 g. Rongalite

(B) 86 g. Aniline

(C) 110 g. Tannin
70 c.c. Water.
16 g. Acridine Yellow (Leonhardt)
10 g. Methylene Blue B (B.)
124 g. Alcohol

A and B are mixed, and this then mixed with C.

The paste is printed upon cotton bottomed with Indigo, the goods steamed 5 minutes in a Mather-Platt in absence of air, then entered directly into a vat (roller) containing 1,000 liters of water at 100° C., 25 liters of 10% soap, and 6 liters of an alkaline tartar-emetic-glycerine solution, prepared as follows:

(D) 2 liters Water
2 kilos Glycerine
500 g. Tartar Emetic

(E) 1 liter Caustic Soda Solution of 20° Be.
D and E are mixed)

The goods are passed for a minute through the boiling bath; the rolls should be below the surface of the bath, to avoid reoxidation of the Indigo-white formed. In this way the tartar emetic and the extraction baths are combined. The goods are then strongly (vigorously) washed, to reoxidize the Methylene Blue, then soaped and washed again.

Simultaneously with the greens, one can obtain white effects by printing with the following:

1 liter British Gum 1/1
150 g. Rongalite C.

The white is perfect, after passing for one minute through the tartar-emetic-soap bath at 100 C.

(The referee, M. Charles Vaucher, to whom the examination of the process was submitted for verification, reports favorably upon it.)

Dyeing of Acetate Silk

English Patent No. 262,830; I. G. Farber-Ind. A. G.—In the dyeing of developed colors upon cellulose acetate, the absorptive power of the fiber toward the dye is increased considerably by the addition of urea or one of its derivatives to the padding bath of naphthol or Naphthol AS, etc., whether with or without the use of formaldehyde. Full and brilliant shades are produced.

Dyeing of Furs

English Patent No. 279,942; British Dyestuffs Corporation, Ltd., R. S. Horsfall and L. G. Lauric.—The addition of certain hydroxyl derivatives or benzene to the dye bath increases the solubility of certain dyestuffs remarkably. For example: Acid Orange G is soluble in water to about 5%, but when mixed with one-half of its weight of pyrogallol its solubility rises to 20%. Phenol, pyrocatechol, resorcinol, hydroquinone and pyrogallol are mentioned as having this effect. The method is of use in obtaining deeper dyeings with furs, and should be of value also in the coloring of such impervious material as horn, bone, ivory and synthetic resins.

Microscopical Examination of Artificial Silk Fibers

L. G. Lauric, J. Soc. Dyers Col. 73, 44 (1928).—The microscopical determination of the different kinds of rayon fibers is more difficult than is the case with the natural fibers, because of the very light differences in structure and marking (striation) brought about through the process used for a particular kind of fiber. In order to make these characteristic markings as prominently visible as possible, certain precautions have to be taken in the preparation and mounting of the material to be examined.

The fibers should first be thoroughly dehydrated by successive immersions in a series of alcohol-water mixtures of increasing alcoholic percentage, up to absolute alcohol. Since such fibers are not greatly liable to distortion (as are vegetable or animal sections) when passed from one strength of alcohol to another, they may safely be passed through 25%, 50%, 75% and absolute alcohol, instead of through a larger series of alcohols of less divergent percentages—about two hours in the dilute, and at least four hours in the absolute alcohol.

Dry mounting is usually of little value, except in special cases, for detection of structural markings. Canada balsam is not valuable as a medium for mounting, Euparal, or glycerine jelly, or in some cases castor oil, giving better differentiation, owing to the greater difference in refractive index. Occasionally highly re-

fractive media, such as bromnaphthalene or styrax, are of use. As usual, clearing agents, such as oil of cedar, oil of cloves, oil of bergamot, or xylene, may prove necessary. Since most artificial fibers are transparent and usually without visible structure, the iris diaphragm must be carefully employed to reduce glare, spurious markings, etc.

Entire Fiber.—Most artificial silks show definite types of structural markings, which the author classifies thus: (1) well-defined striations, which follow the contour of the cross-section; (2) fine striations, probably formed during the stretching in the coagulating bath; (3) transverse striations or cracks; (4) round or eliptical markings, like bubbles; (5) solid impurities, such as solid particles of amorphous matter, crystals, etc.; (6) faults, such as swollen or contracted portions of the fiber. Such markings as these are best brought out by the use of modified illumination, oblique or dark-ground, though oblique illumination requires judgment in its use, on account of the danger of optical distortion and possible false interpretation of the apparent results.

With polarized light, the interference colors are usually strongly marked, and are often characteristic, not only for different kinds of artificial silk, but also for forms of the same kind, produced under different conditions. The fibers for examination should in this case be mounted in Euparal or Canada balsam. The maximum color is produced when the Nicols are crossed. On rotation of the polarizer through an angle of 45°, the colors are reduced to a minimum or to zero; but on further rotation to 90° a new series of colors of maximum intensity appears, as a rule complementary to the former series. Viscose usually gives a two-color fiber, of yellow ground with a red or orange-red central band, with the Nicols crossed; at 90° the ground is blue, with a greenish-blue center. Vistra gives results very like those with Viscose, except that the central band is usually more orange. Sniafil shows a plain yellow fiber with the Nicols crossed, and a plain blue at 90°. Celta shows very little in the way of interference colors, a pale greenish-gray or straw color being produced with crossed Nicols. Traces of blue streaks may be seen in many filaments and appear to be characteristic of this fiber. Cuprammonium silks show plain yellow filaments with Nicols crossed, changing to plain blue at 90°, at an intermediate point the color being reddish-violet. (Both Brysilka and Bemberg silks show the same colors). Cellulose nitrate silks display the most brilliant and diverse interference colors, and can easily be distinguished from other kinds by this property. "They cannot be reduced to a single color formula. Generally they show several bands of color with crossed Nicols; e. g., bands of orange-red-yellow-green-yellow, or yellow-red-green-blue-orange-yellow. At 90° the red changes to blue and the orange to greenish-blue, and vice-versa." Cellulose acetate silks show no interference colors, the filaments appearing uniformly gray between crossed Nicols.

Cross-Sections.—Study of the cross-section of a fiber does not give information, usually, regarding the kind of fiber under examination, but does afford knowledge of certain points which are of value in foreseeing the probable behavior of the fiber in the dye bath, etc. Artificial fibers can be cross-sectioned by the usual Celloidine, paraffine, or gelatine methods of imbedding, but the author regards the Celloidine method as the best, since the imbedding material does not need to be removed after sectioning, and mounts well in most media. In its use for the present purpose much time may be saved (over the method usually employed) by wrapping the fibers, drawn parallel, around a wire frame and immersing for an hour in a solution of Celloidine in equal parts of alcohol and ether, then removing, and coagulating the coating by immersion in chloroform, or simply by drying in air. Or, another simple method of preparation consists in impregnation of the fibers with a solution containing 47.5 parts of gum arabic, 47.5 parts of water, and 5 parts of glycerol. The fibers are saturated with this solution and then dried slowly in a warm air-oven. In sectioning, the rocking type of microtome does not work well, on account of the hardness of the consistency of the mass to be sectioned. The finished slides are best recorded by photographing the sections, or by tracing with a camera lucida. The area of cross-section can be determined by use of a planimeter, by cutting out the drawing (or the photographic print) of the cross-section and weighing, or by tracing on cross-section paper.

Swelling determinations are frequently of value. The author carries these out as follows: a single fiber is laid out on a slide under a cover glass, dry, and about 20 measurements taken at different points, these figures giving the average diameter. A few drops of water are then run under the cover glass, and after about an hour or two (care must be taken that, while waiting for complete swelling, the slide does not dry out again), when complete swelling has taken place, the measurements are made again as before, and the average of these measurements figured with the first average for the desired swelling percentage. Other methods are also suggested. A table of swelling percentages, of twelve brands of fiber, of several types, of artificial silk fibers, is appended, in which the per cent of swelling varies from 2% to 3% for cellulose triacetate, to 53% for Brysilka.

The paper is the text of a lecture delivered by the author before the Manchester Section of the Society of Dyers and Colourists, and is followed by interesting notes of the post-lecture discussion, in which a considerable number of additional minor points (of much interest, however) are brought out. Reference is made also to another paper by the author "On the Use of the Microscope in the Textile Laboratory," in J. Soc. Dyers Col. 73, 42 (1926).

RECENT LITERATURE

For Students of Color

Practical Color Simplified. By William J. Miskella, M.E. Practical Finishing Series—Volume I. Finishing Research Laboratories, Inc., Chicago. 113 pages; 35 illustrations and tables; 7 color plates.

A CHARACTER in one of Moliere's plays expresses surprise when he learns that he has been talking *prose* all his life. The inference is, of course, that most persons have surprisingly little technical knowledge about the most common things they use every day. The number of dyers who are well versed in the theories of color science, for example, is very small; abstract theories of color, most dyers will say, have no apparent relation to the serious bread-and-butter business of dyeing textiles. And yet it is not so hard to prove that an elementary knowledge of color theory can become extremely valuable to anyone who applies color to textiles or to any other material. Learning the theory behind a practice never does the least harm and often opens new worlds of intellectual pleasure to the curious student. In the case of color, dyers studying the theories should have a marked advantage over the man in the street. A concise, readable treatise, like the little book under review, giving the rudiments of modern color science, ought to be of absorbing interest to anyone in the dyeing industry who has not studied color.

The chief merit of "Practical Color Simplified" to students is its simplicity of text, rendered more simple by the skilful use of good illustations, diagrams and color charts. The book constitutes an outline or introduction to more thorough works on color. This feature will stamp it of no interest, on the other hand, to those who have advanced any distance beyond the first steps. For the book is no more than its subtitle implies—a handbook on lacquering, coloring and painting, with concise and elementary instruction on mixing, choosing, harmonizing, matching, lighting and testing colors.

There are references to dyeing, to the fading action of colors and to testing for fastness, but they simply touch on these phases of the larger subject of color as applied to modern industrial products and decoration. The paragraphs on fading, for instance, would seem rather ingenuous to most readers of the REPORTER. But there are other sections of the book that would undoubtedly be of some real educational value to those same readers.

An introduction defines clearly the terms employed in the ensuing discussion of color harmony, matching, mixing, etc. The method of matching is presented as extremely simple, but this is due to the fact that the method is based on the ingenious hand-painted color charts supplied with the book. By means of movable celluloid indicators on these charts it is possible to find quickly the complements of practically any simple tint or shade, to harmonize shades and combinations for mixing and to match any given shade.

In explaining the accepted methods of testing colors, their fastness to light and other agents, the author confines himself to a general description of the Fade-Ometer and an enumeration of its uses. There is no mention of the plans for standardizing the fastness of dyes now under way in this country and abroad. The fading table of exposure under the violet-carbon arc with equivalents in days for various months will give the layman but a faint conception of the complexity of fastness research.

The chapter on color harmony is probably of more practical value than some of the other sections of the book, and should be of considerable interest to designers. The subject is admirably clarified by the color charts previously referred to. The mixing of colors is treated more with respect to lacquers and enamels than to dyes. A description of the various natural pigments, and chapters on Color Lighting, Color Photography and Color Language are of general interest to interior decorators, photographers, artists and workers in allied crafts. The text closes with a brief, somewhat platitudinous discourse on the relation of color to modern business, actually a sketch of the current mania for putting color into every conceivable article of common use, from locomotives to sugar bowls. One feature that would be of inestimable value to the student has been omitted, namely, an up-to-date bibliography of the most authoritative books on color.

Year Book of National Association of Cotton Manufacturers (1928).

THE eleventh edition of the year book of the National Association of Cotton Manufacturers, which has grown in importance and value in the past several years until it has become one of the leading publications of its kind, is now being distributed. Because of the enormous amount of statistical and technical information regarding cotton and the industry that the book contains it is used as a reference work in all of the cotton manufacturing countries in the world.

The present volume includes practically all of the authentic information about the industry that manufacturers and other interested persons might want. Since the publication of the first year book in 1918

changes have constantly been made, new tables added in the statistical and technical sections and revisions made to keep the data up to date. Through continuous effort in eliminating things found not entirely necessary the volume has been kept at a convenient size for reference despite the fact that the 1928 issue is about three times as large as the original number.

New tables have been added in the 1928 statistical section, including those on weight and dimensions of foreign cotton bales and those on premiums on staple cotton in the Memphis market for the last seven years. Statistical tables from the previous issue have been revised. The import and export figures from the earliest date available have been added to the statistical history of the industry in the United States.

In the technical section the list of constructions of standard fabrics has been considerably extended and includes practically all of the great variety of fabrics reported on by the Association of Cotton-Textile Merchants of New York and The Cotton-Textile Institute, Inc., which represents the entire industry in this country. Federal government methods of determining size are to be found in the new arrangement of test methods.

CORRESPONDENCE

THE TESTING OF SULPHONATED CASTOR OILS

Editor, AMERICAN DYESTUFF REPORTER:

An article on this subject by Prof. Albert H. Grimshaw was published in the REPORTER of March 5, 1928, and a communication from W. H. Thomas on the same subject appeared in the REPORTER of May 14.

In Mr. Thomas' letter he adopted a somewhat critical attitude toward Professor Grimshaw's article. We believe that Mr. Thomas has somewhat lost sight of the primary purpose of the article, namely, a resumé of methods by which a textile mill could check roughly the strength of the sulphonated castor oils they buy. A very small percentage of textile mills over the country have the facilities with which to determine accurately the fatty content of oil. Mr. Thomas is correct in saying that all the methods given by Professor Grimshaw are prone to give inaccurate results and the official methods of the American Leather Chemists' Association are certainly a decided advance on any of those enumerated. The method recommended by Mr. Thomas to determine the total fatty matter by adding together the moisture and ash and subtracting from 100 will give a good result. We do protest strongly, however, against judging the quality of a sulphonated castor oil by this means. This method actually attaches a penalty to an oil of very high sulphonation. The ash of a sulphonated oil will have three principal components: First, sodium sulphate, made by the reaction between sodium hydroxide and sulphuric acid; second, sodium sulphate, caused by the ignition of the sodium salts of the sulphonic acids; third, sodium carbonate, caused by the ignition of the sodium soaps. It is evident that if all the sulpho fatty acids are neutralized, the higher the sulphonation the higher will be the ash and therefore the less total fatty matter, provided, in all cases, we have an equal water content.

It is constantly the aim of sulphonated oil manufacturers to attain higher and higher organic SO_3. Some oils are on the market with an organic SO_3 of 7 to 8% on a dry basis; others have an organic SO_3 of 2 to 3%. With an equal water content, the latter class would show about 5% higher fat than the former class, and if quality were judged by this figure alone the result obtained would be sadly amiss.

We believe that Professor Grimshaw's article was written having in mind the fact that the laboratory equipment of the average textile mill is far from that which will be found in the laboratory of a sulphonated oil manufacturer, and that the article should be judged accordingly.

Very truly yours,

C. I. POST,
Chief Chemist, National Oil Products Company.

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